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EDITORIAL.

Malayan Pineapples.

Most residents in Malaya are aware of the regular export in canned pineapples from Singapore; but it is probable that many may not realise the extent and growing importance of this industry. We shall have occasion in a future article to enter more fully into this subject, but for the present, attention is drawn to recent efforts that have been made to increase the demand for this delicacy in the United Kingdom.

For the past two years Malayan (or Singapore) canned pineapples have been systematically advertised through the medium of Exhibitions. In all instances the exhibits have been arranged and staged by the Malayan Information Agency in collaboration with the Empire Marketing Board. The Department of Agriculture, S.S. & F.M.S., has assisted by supplying exhibits, photographs, information and leaflets. We would take this opportunity of thanking the various commercial firms interested in this commodity for their ready assistance.

The first of the exhibitions at which a display was made was at the Imperial Fruit Show in October, 1928, at Manchester, where Malayan exhibits of pineapples attracted considerable attention. The matter was followed up and similar displays were made during 1929 at the British Industries Fair, the Ideal Homes Exhibition, the North East Coast Exhibition, the International Grocers' Exhibition, and the Imperial Fruit Show, Birmingham. Included in such exhibitions were demonstrations of cooking with the use of Malayan pineapples and the sale of a book of recipes of fifty different dishes that can be made from this canned fruit. The success of such methods of publicity are undoubted. For instance, a visitor stated from his observation at the Imperial Fruit Show 1928 that the crowd before the Malayan Stand at any given moment was six times as large as that to be found before any other exhibit in the Show.

It is becoming clear that the efforts made are proving successful. It is reported that representatives of firms are now coming forward voluntarily to offer supplies of their brands to be shewn at stands at Exhibitions. Furthermore, there is every reason to think that the demand for Malayan pineapples is being considerably stimulated by the action which has been taken and that this will in due course react favourably on market conditions.

The exports of Malayan pineapples are taking a more important place in our trade each year. While in 1920 the exports amounted to about 10,000 tons,

the Trade Returns for 1929 state that the exports for that year amounted to 58,692 tons, an increase over the previous year of 12,292 tons or 21%. The exports of pineapples from Singapore are valued at over $9,000,000 and represent the fifth largest export industry in the Peninsula. This production causes Malaya to rank as the second largest producer of canned pineapples in the world, the first being Hawaii.

Over 80% of these exports go to the United Kingdom. It is proposed to continue the publicity campaign and if possible to extend it to the Continent of Europe where a considerable potential market for canned pineapples is believed to exist.

In view of the important trade which is now extending, it behoves the producing industry to continue their efforts in maintaining quality while not enhancing the cost of this "poor man's luxury," and for us to establish the planting industry on a surer foundation than exists today, when pineapple cultivation is considered merely as a catch crop with rubber or other permanent crops.

Coconuts.

In the present issue of this journal will be found two articles dealing with coconuts and copra. The Coconut and Oil Palm Research Committee of this Department has, at their deliberations, exhaustively surveyed the work already accomplished on coconut research both in Malaya and elsewhere, and has drawn up schemes for future research which are designed to have the greatest effect without undue overlapping between the different workers. The present position regarding this subject is outlined in Mr. Sharples' paper on Coconut Research.

It is clear that abundant scope exists for research both in relation to the selection, breeding and cultivation of coconuts and also in the preparation of copra and coconut oil for the market.

One of the earliest steps taken by the Committee was to recommend the delegation of an officer of the Department to enquire into the conditions governing the market for copra and coconut products in the United Kingdom; and acting thereon, Mr. D. H. Grist was appointed by the Government to undertake such an enquiry during a recent period of leave in England. The results of Mr. Grist's enquiries are contained in the report by him published in this number. The report emphasises the fact that the purchase and sale of copra is conducted on very stereotyped lines which militate against endeavours to improve the quality of the produce in the tropics. In such circumstances, producers are bound to find themselves handicapped in the early stages by the fact that attempts to improve the quality of the produce are not certain to be recognised by an immediate improvement in price. Such a state of affairs is, of course, unfortunate; but it may be pointed out that there is hardly a single tropical product for which the market is based on variation in quality which at the outset did not find itself confronted with similar difficulties. The immediate task with which copra producers are faced therefore appears to be twofold: firstly by systematic investigation of ascertaining the optimum conditions

for the preparation of a standardised product and secondly, of convincing buyers that such a procedure represents a distinct advance over the method at present in vogue.

It is interesting to recall that similar proposals were put forward in the Philippine Islands in 1917 but that, so far as can be ascertained, no steps have been taken to give practical effect thereto.

It is to be hoped that the work recently initiated in Malaya, combined with the projected Coconut Research Scheme in Ceylon, as well as the copra research work now being undertaken at the Biological Research Station, Slough, attached to the Imperial College of Science and Technology, will cause attention to be focussed on this point where apparently abundant scope for improvement exists.

Bananas.

Mr. F. S. Ward, Assistant Mycologist, has been engaged for some time on the diseases of bananas, especially that most destructive disease known as Panama Disease. In the course of his researches he has accumulated much information on the local varieties of bananas and the methods of cultivation, which is here placed on record. It is perhaps not generally known that in certain districts there are considerable areas of land under banana cultivation, the produce of which finds its way to the larger towns of the Peninsula. We hear of an enterprising Chinese who has commenced the manufacture of banana flour, a subject which Mr. Ward deals with in an article to appear in the next number of this journal.

Film Propaganda.

Mr. J. Corrie deals in his article contained in the present number with the subject of film propaganda in relation to this Department. In a country such as Malaya, there is a great educational value in films, demonstrations and shows, as a means of appealing to the *rayat*, and the commencement made in film propaganda coupled with the organisation which already exists for demonstrations, agricultural shows and publications in the vernacular should go far towards bringing home to the cultivators the lessons to be learnt from the progress of agricultural science.

The subject of Film Propaganda was discussed at considerable length at the Agricultural Field Officers Conference held in October last and as a result, a joint committee consisting of the Departments of Agriculture, Co-operation and Rubber Research Institute was nominated for the purpose of making concrete proposals. The committee has devised a scheme for co-ordinated work between the three Departments on these lines which involves the organisation of a propaganda van which will tour the country and give displays of agricultural and co-operative films at suitable centres. Financial support for the scheme has already been promised by the Rubber Research Institute and it is hoped that the Federated Malay States Government may be able to see their way to accord its approval of this proposal. Striking successes have already been achieved under not dissimilar conditions in India, while more or less similar proposals are, it is understood, contemplated in Ceylon.

ORIGINAL ARTICLES.

BANANA GROWING IN MALAYA AND THE PRESENCE OF DISEASES.

BY

F. S. WARD,

Assistant Mycologist.

Early Historical References to the Banana.

The original habitat of the edible banana was, in all probability, in the humid tropical Indo-Malayan regions. It appears that the banana was first a root crop, the roots even yet being used by the natives of some countries, while the tender heart was doubtless also an article of food, as it is to-day in Abyssinia. Cultivated for its roots, the banana began to produce better fruits, perhaps by chance, or perhaps as a result of asexual propagation, and at a very early date must have become more prized for the latter than for the former.

From the Indo-Malayan region, according to the generally accepted account, man must have carried the banana on his migrations both eastward to the islands of the Pacific Ocean, and perhaps to America; and westward to India, the Mediterranean region, and finally on to America.

The first clear references to the banana are found in Greek, Roman, and Arabian authors. Pliny is commonly held to be the first writer to describe the banana with regard to which he gives the following interesting account.* "There in another tree in India of still larger size and still more remarkable for the size and sweetness of its fruits upon which the sages (Brahmins) of India live. The leaf of this tree resembles, in shape, the wing of a bird, being three cubits in length and two in width. It puts forth its fruit from the bark, a fruit remarkable for the sweetness of its juice, a single one containing sufficient to satisfy four persons. The name of this tree is pala, and of its fruit ariena. They are found in the greatest abundance in the country of the Sydraci, a territory which forms the extreme limit of the expedition of Alexander." The name pala is said still to be found as a vernacular name of the fruit in India, while his remark as to its being the food of the sages has given the specific name to the ordinary cultivated banana—*Musa sapientum*, "the Musa of the wise men".

Alphonse de Candolle, in his "Origin of Cultivated Plants", says: "The antiquity and wild character of the banana in Asia are incontestable facts. There are several Sanskrit names. The Greeks, Latins, and Arabs have mentioned it as a remarkable Indian fruit. There is an immense number of varieties of the banana in the south of Asia, both on the islands and on the continent;

* Journal of Heredity, Vol. V, 1914.

A typical flourishing hill of Bananas approaching maturity in the Jelebu District.

PLATE I.

An old hill of Bananas in the Jelebu District, showing where " Lalang " grass has been allowed to creep in, due primarily to poor cultivation methods.

PLATE II.

the cultivation of these varieties dates in India, in China, and in the Archipelago from an epoch impossible to realise; it even spread formerly into the islands of the Pacific and to the west coast of Africa; lastly, the varieties bore distinct names in the most separate Asiatic languages, such as Chinese, Sanskrit and Malay. All this indicated great antiquity of culture, consequently a primitive existence in Asia, and a diffusion contemporary with or even anterior to that of human races".

In the Koran, the banana plant is referred to as the paradise tree.

Popenoe states: "There seems little reason to doubt that the banana was one of the first foods of man, and that it was one of the first plants cultivated".

Reference to the banana can be found in the Sacred Books of the East which are generally based upon ancient sources. The banana tree is pictured in early Buddhist art. It is sacred to one of the forms of the Goddess Kali and is especially worshipped on the third day of the month Sravana.

Some of the conditions under which the banana is grown in Malaya.

The cultivation of the banana in Malaya on a large scale has not until recent years been considered as a paying proposition for various economic reasons. The chief of these has been the high cost of transportation and the limited cultivation of this crop, which has been insufficient for the building up of such an industry as the manufacture of banana flour.

The majority of the banana varieties which are cultivated in this country are indigenous to Malaya and can be grown successfully on most types of soil, below an elevation of about two thousand feet, provided that suitable methods of cultivation, drainage, mulching and irrigation are employed. A well drained fine sandy loam is a satisfactory type of soil for banana growing. One of the largest banana growing districts in the Federated Malay States is on undulating land of about two thousand acres with a rich alluvial granitic clay loam (Plates I and III). It appears that the working basis of the latest and most progressive cultivators is that a 'banana soil' and a 'cultivated soil' will soon be synonymous. This applies more especially to Jamaica where in all probability the cultivation of bananas is carried out more intensively than anywhere else in the world.

At the present time, the growing of the banana in this country is practically confined to the Chinese who control the chief markets such as Penang, Kuala Lumpur and Singapore. Owing to the fact that suitable land for bananas is easily obtained, very little attention is given by the Chinese grower to the question of cultivation, draining, mulching or irrigation of the crop and consequently, after about four to five years, when the soil is in a thoroughly bad state of tilth and the suckers are in an unhealthy condition, the land is deserted and another lease is taken out for virgin land for another period of about five years and so on. The result is that large areas of land, whose soil is in a depleted state, lie scattered throughout the banana growing areas (Plate II).

It seems that it is cheaper for the banana cultivator to grow his crop in this fashion rather than retain his land for an indefinite period and practice suitable methods of cultivation and manuring.

The chief cultural problems in Malaya are lack of humus on the old and more particularly, the hilly lands, and the lack of adequate drainage on the flat lands. The former trouble is due chiefly to the leaching effect caused by the heavy rains and the growing of unsuitable catch crops which are heavy surface feeders, such as pineapples, which are commonly grown by the Chinese as an intercrop with bananas. To increase the humus in the soil, a leguminous intercrop such as ground-nuts, lima beans or velvet beans should be grown in order to prepare the land for replanting. A satisfactory system carried out in Jamaica is to replant a certain proportion of a banana field each year so that every year there is some planting going on. Advantage is taken of this interval to increase the humus in the land by growing a leguminous crop.

Cultivated Malayan Varieties.

The chief commercial varieties which are cultivated are "Pisang Embun", "Pisang Mas", and "Pisang Restali". Some of the less important banana varieties which are grown are, "Pisang Rajah", "Pisang Mundan", "Pisang Talon", "Pisang Laing", "Pisang Masak Hijau", "Pisang Nangka", "Pisang Awak Legor", "Pisang Awak Betol", "Pisang Serendah", "Pisang Rajah Udang", "Pisang Kapas", "Pisang Abu" and "Pisang Tandok". A few notes on some of these varieties are as follows.

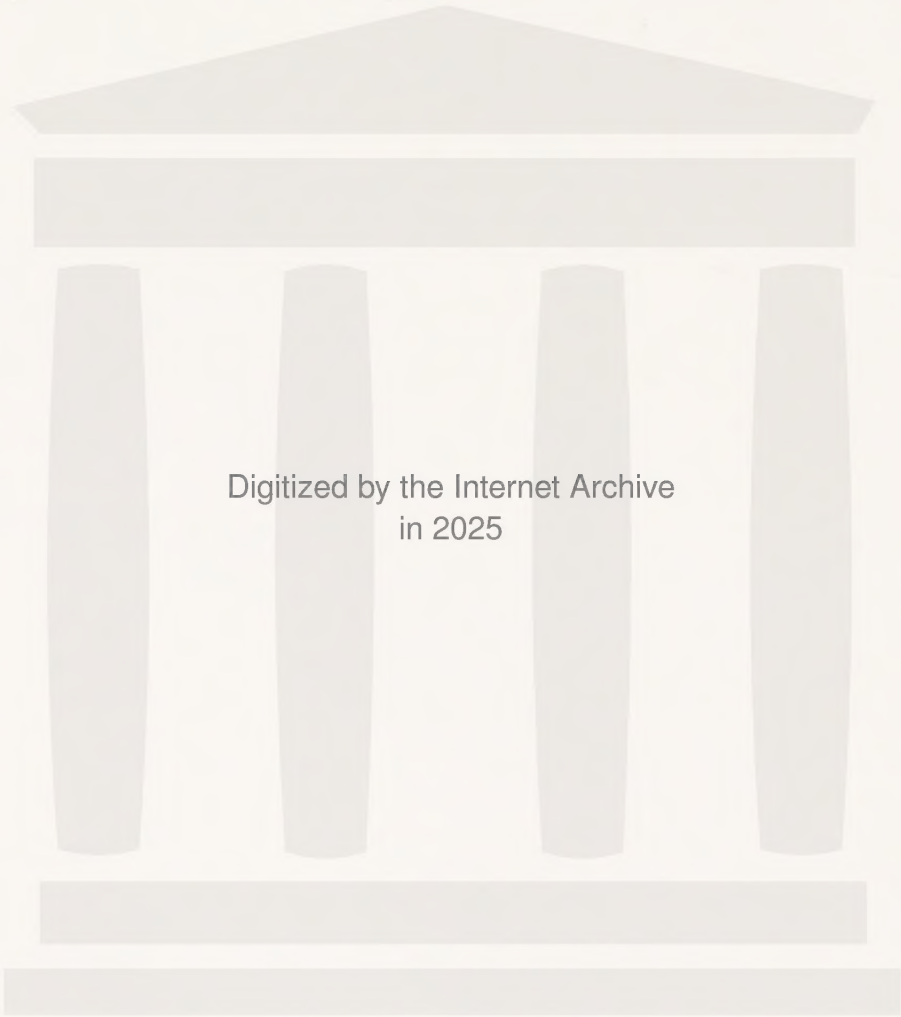
"Pisang Embun," also known as "Pisang Medji" and in Penang as "Pisang Bunga".

This is one of the most popular varieties amongst both Asiatics and Europeans (Plate IV). The hands are evenly spaced and the fingers, which are large, well filled and of uniform thickness, are generally curved in the neighbourhood of the pedicel and lie adjacent to one another throughout the greater part of their length. This variety closely resembles the "Gros Michel" or "Jamaica" banana and is identical with it according to Dr. O. A. Reinking, who has just completed an extensive tour of the East where he made an exhaustive study of the varieties of the bananas found growing there. In some localities, well grown plants attain to a height of fifteen feet. The pseudo-stems are usually mottled considerably with black markings. The leaf sheaths near the point of attachment to the petiole are covered with a white waxy substance in the young stages. The usual number of hands per bunch is about eight to ten and the number of fingers per hand about fifteen to seventeen. The fingers are from six to eight inches in length and one and a half inches in diameter.

"Pisang Restali."—The "Pisang Restali" of Malaya is quite a distinct banana from the Restali of Southern India. It is grown a great deal in certain areas only, particularly Western Johore, where an alternative name for the variety is "Pisang Kling" which is different from the "Pisang Kling" in the

Young banana suckers on recently opened up land in the Jelebu District. At the present time the bananas in this district cover an area of about three thousand acres.

PLATE III.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Federated Malay States. These names are suggestive of the variety having been introduced from India at one time or another.

A feature about this variety is that the fruit is not at its best when full yellow but improves in quality and flavour as the skin becomes brown and black. The fingers are generally four to four and a half inches long and one and one quarter inches in diameter; of uniform thickness and ridges not at all pronounced. The skin is very thin, thus preventing it from being a suitable variety for export, and quickly becomes covered with brown spots.

"Pisang Mas".—This variety, known also as the "Golden Banana" (Mas = golden) is regarded by many as the most choice of the Malayan varieties (Plate V). It is cultivated very extensively in some areas by the Chinese and always commands a higher price than other varieties. The fingers are small, not more than three inches long and one and a half inch in diameter and project more or less at right angles to the stalk of the bunch. The skin is very thin, rendering the fruit very liable to bruising. It is unsatisfactory for export purposes owing to the delicate nature of the fruit and its small size and bad shape for carrying.

"Pisang Masak Hijau".—This variety is sometimes known as Pisang Hijau and is characterised by being yellow-green when ripe and never attaining to a truly yellow colour.

The habit of the plant, size and shape of the bunches and fingers, are identical with those of "P. Embun" excepting that in the former case there is a tendency for the fingers to fall away from the bunch at an early stage.

"Pisang Tando", spelt also "P. Tandok".—A large horned variety of banana (generally consumed in a cooked state). The whole bunch has generally only two or three hands, if the cluster is reduced to a single fruit, the latter becomes exceptionally large. The individual fruits are usually about a foot long and two inches in diameter. This variety is common in Borneo and has been found to be the most satisfactory in the manufacture of banana flour.

"Pisang Rajah".—This variety is grown to a fairly large extent but is not so common in Malaya as "P. Embun", "P. Restali", "P. Mas" and "P. Masak Hijau". In Java, however, it is quite one of the most popular and extensively grown varieties. The plant is of sturdy habit—eight to twelve feet in height with a purple marking on the two margins of the leaf petiole. The bunches are compact with generally seven to eight hands and fourteen to sixteen fingers per hand. The fingers have rather a pronounced apex and taper gradually to the pedicel at the base, being usually five to six inches in length. Three or four rather prominent ridges are generally present and the skin is of medium thickness. Ripe fruit is buff in colour with a tendency to retain the green colour slightly along the ridges.

"Pisang Rajah Udang".—This is the only red variety encountered in Malaya. Pigmentation extends throughout the whole plant except the lamina and is particularly noticeable on the pseudo-stem and leaf mid-rib. Bunches with eight to nine hands are common, but no doubt under very favourable conditions

considerably larger bunches might be expected. The fruit is a dark red brown when immature, but on ripening assumes a yellow tinge, particularly when exposed to full sunlight. Ripe fruit is well filled with little or no sign of ridging, five to five and a half inches in length and one and a half inches in a diameter.

This variety is not much grown by the native cultivators in Malaya, no doubt on account of the popular belief among Malays that it causes a skin complaint which affects those who consumes the fruit.

The interesting example of a yellow bud mutant of the red banana ("Pisang Rajah Udang") was observed on a rubber estate in Eastern Johore. From a single plant of the red banana one of the suckers in a subsequent season was found to bear yellow fruit instead of red. Out of interest, the owner removed this sucker and later established other starts from it. Except for lack of pigment throughout, and a slightly paler flesh, this yellow mutant in no wise differs from the original red form.

"Pisang Serendah".—This variety is one of the Cavendish forms (*Musa Cavendishii* Lam. var.) as can be seen from a glance at the dwarfed broad-leaved habit of the plant. This variety is known also as the Chinese or Canary banana.

It is the only representative of the Cavendish species seen in Malaya and may possibly be of fairly recent introduction, as it appears to be by no means widespread throughout the Peninsula, in spite of the excellent qualities of the fruit and the fact that it grows readily. The fruit of this variety does not assume a rich yellow on ripening but remains greenish yellow. Otherwise it is similar to the typical "Canary" banana and is of excellent flavour.

"Pisang Awak Betol".—This variety is interesting in that seeds are frequently found in the fruit. Bunches with ten hands and fifteen to seventeen fruits per hand are commonly found. The fruit tapers to rather a sharp point and is usually three and a half to four inches long and one and a quarter inches in diameter, not unlike "Pisang Restali" in shape. The skin is frequently spotted. Together with "Pisang Awak Legor" the variety is cultivated a good deal in parts of Selangor.

"Pisang Kapas".—The name given to this variety (Kapas=cotton) possibly has reference to the texture of the fruits. The hands stand out at right angles to the rachis and show no signs of curling over until fairly well developed. The feature is all the more noticeable on account of the hands being situated some distance from one another on the rachis. Bunches with nine hands averaging seventeen fingers per hand were seen. The fingers, four to four and a half inches long and only slightly curved, are yellow when ripe with yellow flesh. The lack of compactness in the bunches and tendency for the fingers to stick out, disqualifies this variety from being of any value as a shipping variety. Furthermore, the flavour is not good.

"Pisang Brok Bakul".—This variety is regarded by cultivators as a heavy yielder. The plant is characterised by a certain amount of red or pinkish colouration, noticeable particularly on the mid-rib and leaf petiole. Bunches with eight hands averaging sixteen fingers per hand are common. The fruit,

Showing two mature " Pisang Embun " suckers in the foreground.
This variety is interplanted with the " Pisang Mas " in the Jelebu District.

Showing a mature "Pisang Mas" sucker in the foreground, also Pineapple plants which are commonly grown as an intercrop with the "Pisang Mas" and "Pisang Embun" Bananas in the Jelebu District.

five and a half inches long, is plump and well filled, with a pedicel about half an inch long. The flesh is pale yellow with a dark area located in the centre.

"*Pisang Abu*" (Abu=ash).—This is a very distinctive variety in that the fruit and the under-side of the leaves are covered with a "bloom" of light coating of a white waxy substance. This substance is the same as that which is found on the so-called "wax banana" which is common in Java, the leaves of which are covered on the under-side with a similar minute white powder. The Javanese scrape this meal together, melt it over a fire, and produce a valuable wax. The wax thus obtained becomes very clear, hard and whitish and forms an important article of trade in middle Java. Bleaching renders it very white. One banana tree (with seven leaves) yields two ounces of wax. As there are thousands and thousands of plants growing in a wild state over large areas, the preparation of the wax is a remunerative enterprise. There are no records of the collection of wax from this variety in Malaya.

The fruit of the "Pisang Abu" is four to four and a half inches long and about two inches in diameter with a yellow skin when ripe and with white flesh. It is regarded as a cooking variety and sub-varieties exist.

"*Pisang Nangka*".—This is one of the larger cooking varieties and is grown a great deal in Johore. The fruit is eight to nine inches long and up to one and three quarter inches in diameter. The flesh is pale yellow.

"*Pisang Talon*".—This is no doubt the largest fingered variety in Malaya and is a typical cooking banana. It is very similar to the variety "Nendren," so common on the Malabar Coast in India. Fingers may be almost a foot in length and up to two and a half inches in diameter.

The Presence of Diseases and Pests.

The banana areas in Malaya are comparatively free from any very serious form of disease at the present time. The disease which has been responsible for the greatest losses is Panama Disease, caused by the fungus, *Fusarium Cubense*. This disease exists only in an endemic state in Malaya and so far it does not show any indication of reaching the alarming proportions which it has attained in Jamaica and in Central America. Unlike most other banana producing countries, Malaya is not limited to one or two important varieties and owing to the fact that there are several good commercial varieties which are not, as yet, affected with Panama Disease, there is no immediate cause for alarm.

The varieties which have proved to be the most susceptible to Panama Disease are "Pisang Embun" and "Pisang Restali," and to a less extent, "Pisang Talon." The first named is the most important commercial variety. All of these varieties show degrees of susceptibility under different physiological conditions, as has been shown by various inoculation experiments. Moisture

is the most important factor with regard to the incidence of this disease, the worst outbreaks occurring during the rainy season, while during the drier weather there is much less evidence of disease symptoms.

The soil organism causing Panama Disease affects the vascular tissue only and internal symptoms of disease are first apparent in the roots or cut end of the sucker and afterwards appear throughout the rhizome and eventually in the above-ground parts. A cross section taken near the base of the pseudo-stem of a diseased plant shows the cut surface with rows of yellow, orange, red or red-brown spots which mark the position of the diseased vascular bundles. The distribution of the diseased fibro-vascular bundles is usually more concentrated towards the central portion of a diseased plant and the occurrence of a central rot associated with the massed bundles is of value in distinguishing Panama Disease from diseases in which the rot extends from the periphery. There may, however, even in Panama Disease, be no development beyond a suffused yellowing and softening of the upper part of the bulb.

Bacterial vascular diseases of the banana exist whose internal and external symptoms are very similar to the Panama Disease. These bacterial diseases are Blood Disease, caused by *Pseudomonas celebensis* and the Javanese Vascular Disease caused by *Pseudomonas musae*. These diseases are met with fairly commonly in the Dutch East Indies but have not yet been found in Malaya. The external symptoms peculiar to Blood Disease are: (1) the yellow stripe effect on the leaves; (2) the particular discolouration occurring on the fruits. In the case of the Javanese Vascular Disease, the typical symptom is the diminutive size of the heart of the crown.

A peculiar form of bacterial wilt affecting only "Pisang Restali" bananas was found in Johore a few years ago. This disease soon disappeared and has not been recorded since. The causal organism is very similar to *Bacterium Solanaccarum* which causes the bacterial wilt of bananas in Trinidad and was investigated by Ashby. The external symptoms of the bacterial wilt disease affecting the bananas in Johore were practically the same as those found in Panama Disease. In the bacterial form, a transverse section of a diseased rhizome showed a yellow-white exudate from the exposed surfaces. The only indication of decay within an affected plant was usually a black ring about halfway between the centre and periphery of the section. Usually there was no red or brown discolouration of the vascular bundles elsewhere.

Periodical outbreaks of the insect pest known as the leaf-roller (*Erionata thrax* L.) occur in most banana areas and often with quite serious results. The defoliation effect is usually sufficiently severe to cause the production of inferior fruit bunches. These outbreaks are largely influenced by the prevailing weather conditions. Dry periods appear to be the most favourable for the spread of this pest. All of the cultivated varieties appear to be equally susceptible to attacks by this insect. The two wild varieties *Musa violescens* and *Musa malaccensis* are not affected.

The banana weevil borer (*Cosmopolites sordidus*) does the greatest amount of damage in areas where there are poor soil conditions. In connection with Panama Disease, it has been suggested by Dr. Wardlaw, the Banana Pathologist at the Imperial College of Tropical Agriculture, that the weevil-borer may be an important accessory factor as regards acting as a wounding agency. Experiments in this country have shown that Panama Disease existing in a particularly endemic and virulent form, the weevil-borer seldom acts as an accessory factor in the spread of this disease. Inoculation experiments also show that the weevil-borer enters into the rhizome of a sucker after Panama Disease has established itself.

COCONUT RESEARCH IN MALAYA.

BY

A. SHARPLES,

Government Mycologist

and

Acting Assistant to the Director of Agriculture.

Up to the time of the formation of the Rubber Research Institute of Malaya, the main activities of most of the research divisions of the Malayan Department of Agriculture were necessarily confined to the investigation of rubber problems. Coconut investigations, however, formed a main line in the Divisions of Economic Botany and Entomology long before the inauguration of the Rubber Research Institute and since 1920 much work has been done on coconut research by the officers of these Divisions. When the rubber work of the Department was taken over by the Rubber Research Institute, other Divisions devoted more time to coconut problems, so that at the present time this crop is receiving a considerable amount of attention as regards research necessities.

In 1920, the Division of Economic Botany commenced taking individual yield records with a view to studying variation in individual palms. In 1922, an Experimental Coconut Plantation of 50 acres was started between Klang and Port Swettenham and planted up with seed nuts of known origin.

The study of variability in coconuts by the Division of Economic Botany up-to-date has shown that as regards fruiting qualities, the co-efficient of variation in the number of nuts produced per annum is as high as 34% of the mean production per palm under average estate conditions. The study of variation has also revealed the fact that 19% of the palms on the average estate are unprofitable. Fruiting characters of individual palms have been found to be definitely constant over a period of eight years and no doubt this constancy also exists as regards the oil content of copra from individual palms within the range of seasonal variation. Investigations on this point are already in hand by the Chemical Division.

The entomological work from 1920 onwards included investigations into the life history of the more important pests of coconut palms and the following special bulletins have been issued.

(1) The Two-coloured Coconut Beetle (*Plesispa reichei*).

(2) Red-Stripe Weevil of Coconut (*Rhynchophorus schach*).

Further considerable work on the Black Beetle (*Oryctes rhinoceros*) and the influence of *Tirathaba rufivena* (Greater Spike Moth) on immature nut-fall has been undertaken.

The study of diseases of coconut palms was under investigation during the days of intensive rubber work but after 1926 this work was considerably acce-

lerated. The work was mainly concentrated on the elucidation of the so-called "Bud-Rot" problem. In 1922, a paper was published in the Annals of Botany describing inoculation experiments which led to the conclusion that the problem had not been finally settled and that, as far as Malaya was concerned, the whole subject needed reinvestigation. Numerous articles on coconut diseases have since been published and in 1928 a special double number of the Malayan Agricultural Journal was published giving the results of the work up-to-date. The important results may be summarised as follows:—

(1) No evidence has been found to support the suggestion that a form of epidemic Bud-Rot, caused by parasitic organisms, exists in Malaya.

(2) That Lightning is of primary importance in the question of so-called Malayan Bud-Rot and probably of other affections.

(3) That *Marasmius palmivorous n.s.* plays a role of some importance in so-called Bud-Rot manifestations in Malaya.

In 1928, a report entitled Copra Manufacture, by H. C. Sampson, was received in which he reviewed the present Empire position with regard to quality of copra and the possibilities of improving the quality, with suggestions as to the relevant lines of research and the place where the work could be best undertaken. The report suggested *inter alia* that "Malaya seems to offer the best scope for carrying out this work for not only is copra becoming of increasing importance as an export from there, but the country probably has better facilities in the way of staff and equipment than is possessed by other colonies interested in this matter. It would be a much better country than Ceylon since the climatic conditions in the main coconut growing districts of that island much more closely resemble those of the West Coast of India where sundrying is largely practised."

As the matter was of considerable (Imperial) importance economically, the Empire Marketing Board, after consultation, expressed their willingness to provide a contribution towards the cost of the Research, an offer which the local administration accepted. The more immediate work on copra research obviously demanded study from the chemical point of view, and arrangements for the special appointment of an Assistant Chemist for Copra Research were made on the initiative of the Empire Marketing Board. The appointment was filled, and this officer assumed duties in October, 1929.

The question of the appointment of a Copra Research Chemist was under discussion when the Director of Agriculture arrived in Malaya in 1929. The Director of Agriculture suggested the formation of a Departmental Copra Research Committee, with the object of correlating the various lines of work in progress, and making suggestions for its extension on properly co-ordinated lines, the Heads of Divisions to sit as members with the Government Mycologist as Chairman. This Committee held its first meeting on April 14th, 1929, and made a number of recommendations relative to the desirability of collecting information on the subject of copra manufacture in Ceylon and the marketing

of copra in England. As a result, the Government on the recommendation of the Director of Agriculture approved:—

(a) of an officer being deputed to obtain information as to the market standards required by copra dealers in England and data concerning other factors influencing the price of copra on the English markets. A report on this subject has been lately submitted by the officer in question (Mr. D. H. Grist, Agricultural Economist).

(b) of an officer being deputed to visit Ceylon with a view to obtaining information relative to manufacture of copra in Ceylon, for purposes of comparative study. Subsequently, a schedule was submitted by the Committe to the Director of Agriculture indicating various additional lines of work which appeared to offer prospects of yielding useful information.

A considerable amount of useful research work on copra had already been achieved by the Chemical Division. This work comprised particularly:—

(a) Analytical comparison of the composition of Malayan copra with Ceylon and Malabar copra.

(b) Studies of variations in oil content of copra from selected palms. This work was being carried on in collaboration with the Economic Botanist.

With reference to (a) the work so far performed appears to indicate that commercial Malayan copra is of lower oil content than copra from Ceylon and Malabar, but this result required confirmation by further analyses. In the opinion of the Acting Agricultural Chemist, the alleged inferiority of Malayan copra may be largely due to climatic causes. Efforts will, therefore, be made to obtain further information on this point by importing seed nuts from Ceylon and Malabar, and by making enquiries in this country to ascertain whether any seed nuts have ever been imported from Ceylon, in addition to those at Klang Experimental Station, the trees from which are not yet in bearing. As a result, a provisional outline programme of work on copra research was formulated as follows. This programme may be subject to modification as experience is gained.

(a) The Assistant Chemist for Copra Research on arrival in Malaya should in the first place undertake a series of tours through the Malayan coconut districts with the object of obtaining a general knowledge of the various conditions associated with the coconut industry. These have already been commenced.

(b) After the preliminary survey, a detailed study of the production of copra stage by stage would be commenced. The following items indicate the more important lines to be followed:—

1. Systematic comparative analysis of native and estate copra from different districts in Malaya, Borneo and Sarawak.
2. Examination of further samples of copra from other countries, e.g. Ceylon and Malabar and a detailed comparison of actual nuts from Ceylon, Malabar and Malaya—also microscopic comparison.
3. Laboratory experiments on the colour of soap produced, and the bleach-

ing properties of coconut oil derived from copra from different sources—these tests are used in the soap and edible oil industry for grading oils.

4. Structural examination, radially and tangentially, of nuts of various shapes, sizes and states of ripeness in order to determine the best sampling position to be adopted in the succeeding work.
5. An elaborated examination including tangentially sectioning of under-ripe, ripe and over-ripe nuts derived from two high yielding and two low yielding palms.
6. The same from a palm yielding uniformly small nuts, and one yielding uniformly large nuts.
7. The same from palms of different ages, and also of different types—in conjunction with chemical analysis of soils and fruits.
8. Thinning out the flowers or young fruit to note the effect on the yield and oil per cent of copra.
9. A study of tapping for toddy, noting its effects on yield and oil per cent of copra.
10. An elaborated study of the structure and growth of coconuts obtained by dating individual nuts, immediately the spathe opens, and by picking individual nuts daily between 200 days and until natural nut fall commences, including microscopic examination and f.f.a. (i.e. free fatty acid) determination.

    The basis of comparison between the individual nuts will be the "ripeness factor" or "total oil per unit area of meat" (Oil % Wet x Thickness of Meat x Sp. Gr. Meat) which will, it is anticipated, effectively overcome individual differences in shape, size, meat thickness and erratic development of the nuts examined. In this connection, neither Total Oil nor Oil percentage (dry) is considered here an effective method for studying nut development.
11. Bulk determination of the total oil derived from 100 ripe ungerminated nuts and 100 partially germinated nuts and 100 young nuts, and the same for nuts kept one, two and four months longer before opening.
12. The preparation of a comparative statement of the picking systems in vogue on different plantations and the copra obtained (quality copra and oil yield per 1,000 nuts).
13. An examination of the working costs of different methods of collection and estate transport and the effect, if any, on the copra obtained.
14. The preparation of a comparative statement of the Capital Cost, Maintenance and Repair Charges, Life of Plant, Labour Costs, Capacity, Speed and Efficiency of existing driers and of the proprietary driers at present on the market.
15. A comparison of the working temperature and humidity conditions; and of the colour, structure and quality of the copra obtained by the existing methods:—Sun-drying, smoke-drying, simple hot air drying,

and chula drying and also of perfect copra obtained on a small scale under laboratory conditions.

16. The effect of washing the meat in water, 2% formaldehyde, hypochlorite or sulphurous acid before drying.
17. The effect of 'sulphuring' during drying.
18. The effect of the size of coconut meat on the rate of drying, and subsequent mould formation.
19. Small-scale experiments in burning coconut shell, using forced draught —consideration of the use of a gas producer as a source of heat.
20. Small-scale laboratory experiments under varying conditions of drying, noting structure and physical condition of resulting copra.
21. The effect on mould formation, of chopping the copra after drying.
22. A study of the storage of the different types of copra from different sources under warehouse conditions, noting variation in oil, f.f.a. and moisture.
23. A study of the maintenance of low moisture content, or its fluctuation under conditions of varying humidity for copra of different physical structure.
24. A study of mould, f.f.a. formation and insect attack under varied conditions of temperature and humidity.
25. A comparison of clean and mouldy copra from the same source.
26. The effect of mixing (on a 25%, 50% and 75% basis) of estate with native copra, noting results.
27. A study of the temperature and humidity conditions in a copra cargo boat with a view to possible improvements.
28. The actual preparation on a large scale of copra containing 72% Oil and a comparison between it and that derived from Ceylon and Malabar, and the working oil and copra yield per 1,000 nuts.

In addition to the above, a considerable programme of research work on coconuts is in hand in the various Divisions of the Department. The following may be mentioned:—

(a) The selection and breeding of improved strains of coconuts.
(b) Manurial and cultivation experiments.
(c) Pests and diseases of coconuts.
(d) Catch crops and cover crops in coconut cultivation.

The preliminary work on the structure of the coconut fruit has been started and although only a few months have been spent on the work, important subsidiary indications have been obtained.

Variation in oil content has been studied in (a) for different nuts and (b) for different parts of the same nut.

The results for (a) show that a considerable variation exists in oil percentage (D.B. = dry basis) in pieces of meat derived from nuts normally picked on Malayan estates as shewn by a range from 45% to 75%. The copra result-

ing, from which the individual pieces were picked, will probably show the same variation; this indicates that there is considerable room for improvement if a more uniform product with a higher average oil content can be produced.

The results for (b) show considerable difference in oil percentages in pieces of meat from different parts of the same nut, most particularly in nuts not fully ripe. This throws considerable doubt on the utility of any nut sampling which has been done in previous experimental work when the state of ripeness has not been specified and when the sampling has been done at random.

Experiments in the selection of the best sampling position have shown it is desirable to take samples near the middle of the nut and not from the ends where extreme differences are found. Further, when tangential slices are examined, an oil gradient has been determined, with the lowest oil percentage on the inside face of the meat gradually increasing in value as slices are taken nearer the shell. In these preliminary experiments, the difference in oil percentage of a 1/10 inch slice of meat from the inside face as against a similar piece nearest the shell seems to show a fairly constant difference of 38%—40%. This applies only for a ripe ungerminated nut; the meat from nuts containing a germinating embryo does not show this oil gradient.

The effect of ripeness on oil yield has been studied fairly extensively and the results show that there is an increase in oil percentage as the nuts germinate and become over-ripe. In the samples examined, an average increase in oil percentage was found, from 63% when the nuts were considered to be ripe, up to 72% when the nuts held a germinating embryo $3\frac{1}{2}$ inches in diameter. This result confirms the studies made by analysing tangential and radial slices of meat. This finding may have some significance in the question of the apparent superiority of Malabar and Ceylon as compared with Straits copra, if it is correct that, in Malabar, the nuts are allowed to fall naturally, while in Ceylon there is a longer ripening period and the nuts are kept for a considerable period after plucking. The question of whether the total oil in the nut continues to increase after the nut is considered to be ripe has still to be determined, but it appears that the best plucking age will be an important economic factor, if copra should ever be valued according to oil content.

Further work on copra deterioration has been done and it has been shown that badly deteriorated samples of native manufactured copra may show the remarkably high average oil content of 67.2% which is 2% in excess of the average for large good quality samples of Malayan estate copra.

During deterioration it may be accepted that the total oil content is diminished owing to the degradation of the actual oil containing meat, which will result in a net loss in weight of copra, by agencies such as moulds, insects and heat. But it is a fact that such copra when analysed may show a high oil percentage content with usually a high development of f.f.a.

The preliminary experiments have provided very interesting results and confirmatory and extensional experiments are being carried out.

A comprehensive scheme of research work on coconuts has been proposed in Ceylon, and a special research station for this crop is being organised in that country. Copra research work is also being undertaken at the Biological Station, Slough, attached to the Imperial College of Science and Technology, London, and discussions are in progress with a view to establishing co-operation between Malaya and these stations. Every effort will be made to maintain touch with all research stations undertaking coconut research work, as lack of such co-operative effort often leads to unnecessary duplication of effort.

It is proposed that a half-yearly report on the progress of the copra research work will be published and so soon as sufficient experience has been obtained and the work of the Copra Research Chemist has become established along sound lines, definite proposals for the erection of one or more experimental driers will be put forward. The results of completed pieces of research will be published as bulletins of the Department of Agriculture, while summaries thereof will appear from time to time in the Malayan Agricultural Journal.

REVIEW OF THE COPRA MARKET (OCTOBER 1929).

BY

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Agricultural Economist.

Introduction.

The world's marketed production of copra is estimated to be slightly in excess of one million tons per annum, of which Malaya's exports form nearly 20%. The product is graded on the European market according to the country of origin; the accompanying table indicates the existing grades, the average prices obtained, and the approximate quantities shipped annually.

TABLE I.

Grades and Values of Copra.

Grade	Average price per ton (Nett Cash C.I.F.) London	Average Quantity Shipped per annum (Tons)
(a) F.M.S. Ceylon ...	£24. 5.0	95,000
F.M.S. Java ...	23.10.0	40,000
F.M.S. Straits ...	23. 7.6	180,000
M.S. Straits ...	22.12.6	
F.M.S. Dutch East Indies ...	23. 7.6	360,000
M.S. ...	22.12.6	
F.M.S. Ceba ...	22.17.6	200,000
F.M.S. Manila ...	22.10.0	
F.M.S. South Sea ...	22.17.6	150,000
Kiln dried South Sea ...	22.10.0	
Average	£23. 1.9	Total 1,025,000 tons

In view of what follows, it should be noted that those grades which command the highest price (F.M.S. Ceylon and F.M.S. Java) bear but a small

(a) F.M.S. = Fair Merchantable sundried.

proportion (approximately 13%) to the total quantity marketed; while exports of the high grade Malabar copra have entirely ceased.

The Decline in the Price of Copra.

A review of the existing condition of the copra market cannot be undertaken without comparing this oil seed with the remaining oils and oil products. During recent years, the price of oils and fats generally has appreciated. Thus, taking the pre-war index price as 100, the average price of oil seeds in August 1929 stood at 137, that of oils and fats at 122, and oil cakes at 155. (It may be of interest to compare these figures with Cereals at 140 and "Sundries"—including such widely dissimilar products as beef and iron—at 119). The only two oil seeds which do not share this prosperity are copra and palm kernels, the figures for which are 90 and 93 respectively (i.e. they are actually below pre-war level). It will therefore be observed that, at present, other oil seeds command a price approximately 50% higher than that of copra, from which it may be argued either that other oil seeds are too expensive or that copra is too cheap. Whichever of these alternatives is correct, the current opinion of many on the market is that copra has about reached its rock bottom price, but that its recovery will be slow.

The decline in price of copra is shewn by the following figures, which shew the average price of F.M.S. Straits Copra C.I.F. London during the past few years.

TABLE II.

Average Prices (C.I.F. London) for Straits Copra.

Year	Price per ton	Year	Price per ton
1916 ...	£33.13.0	1923	£27.17.6
1918 (controlled) ...	45.10.0	1924	29.15.0
1919 ...	52.10.0	1925	30. 5.0
1920 ..	56. 7.6	1926	28.12.6
1921 ...	30.12.6	1927	27.10.0
1922 ...	24.15.0	1928	26.17.6

It will be observed that since 1925 the price of copra has steadily depreciated by nearly 10%.

Reasons for the Decline.

It should be clearly understood that the fall in the price of copra must be attributed to a number of causes and not to any one cause in particular. It has been asserted that the activities of a combine of crushers, which is said to control the European market to a great extent (especially in edible oils), has brought about the present slump. While there is no doubt that the combine can affect prices, the writer is of opinion that the principal reasons which have assisted their ends were actually outside their control.

During the past decade, there has been a very striking increase in the world's production of edible oils. The part played by copra in this increase is shewn in the accompanying table, supplied by the Empire Marketing Board and based on figures published by the International Institute of Agriculture.

TABLE III.

World Exports of Copra (in thousands of tons).

	1909/1913 (average)	1914	1925	1926	1927	1928
British Malaya ...	4	92	86	104	97	95
Dutch East Indies ...	234	338	335	371	300	431
Philippines ...	128	154	145	171	196	254
Ceylon ...	41	88	113	121	99	99
South Seas ...	70	139	148	159	159(a)	—
Unspecified ..	68	64	80	82	62	—
Total ...	545	875	907	1008	913	

Similar increases have been experienced in the case of oils and fats which compete with copra. The principal competitors at the moment are ground nuts (the exports of which are shewn in the accompanying table), and whale oil.

The future planting of ground nuts will undoubtedly be liable to fluctuation according to the trend of prices.

(a) Provisional.

TABLE IV.

World Exports of Ground Nuts (in thousands of tons).

	1909/13 (average)	1924	1925	1926	1927	1928
British India ...	192	243	463	444	475	749
French West Africa ...	205	312	444	480	404	386
British West Africa ...	64	139	176	188	160	195
China ...	39	196	168	176	—	—
Unspecified ...	55	102	82	89		
Total ...	555	992	1,333	1,377		

The production of whale oil, which is largely used in the edible oil trade, has made great strides in recent years. Figures of production indicate an increase from 109,000 tons in 1922 to 203,000 tons in 1927 and 226,000 tons in 1928. Production in 1929 is expected to shew a further material increase. There is reason to believe that local copra producers do not realise that whale oil is perfectly suitable for margarine production, and is in no way inferior to copra oil for this purpose. The whaling industry is better organised than ever before and the number of companies engaged in whaling has increased considerably of late. Whale oil at £25 per ton is said to give a profit to the producer of 25%. Little appears to be known of the habits of whales, and it is therefore impossible to compute the apex of production of this class of oil; but it seems reasonable to anticipate that the slaughter of increasing numbers of whales must soon affect the amount of oil available from this source, by reason of the decrease in their population. At present, however, copra oil is quite unable to compete with whale oil for edible purposes. The present slump in glycerine has also had its effect on the price of oils and fats for the production of soap.

Quality of Copra.

The existing method by which purchasers of copra estimate its value is entirely based upon its appearance to the eye. A visitor to the London Copra Association, a body whose sole function is arbitration between buyer and seller, will find no apparatus for chemical analysis, but merely a long bench in front of a window on which the samples are exposed to the scrutiny of the arbitrator. Although this method may appear unreliable, it should be remembered that it is based upon the experience of the valuer who appreciates the relationship bet-

ween external characters and oil content; and that this relationship is based upon the fact that good appearance indicates careful preparation, with low moisture and free fatty acids content, and therefore a comparatively high oil content. The method has the advantage of enabling large numbers of separate consignments to be marketed without the delay entailed by chemical analysis.

In the valuation of copra by appearance, the following points are taken into consideration:

(a) *Colour.* The colour should be as white as possible.

(b) *Size & Thickness.*—The copra should be thick and should not contain too great a proportion of small pieces.

(c) *Cleanliness.* The copra should be free from extraneous matter.

(d) *Moisture.* Air-dry and free from moulds.

A white copra will produce an oil of good colour. Thick large copra facilitates crushing, and lessens the liability to development of free fatty acid. Moulds are related to a high free fatty acid content and are caused by delay in drying the copra or by subsequent damage by water. Rapid drying is essential for the production of good copra. Moisture causes copra to deteriorate very rapidly; and once it has become wet, although again dried subsequently, the fact remains evident in the poor condition of the copra. Finally, the presence of pests naturally deteriorate the copra.

TABLE V.

Quality of Copra.

Origin.	Percentage.		
	Oil.	Moisture.	F. F. A.
F. M. S. Dutch East Indies ...	66	4	0.8
F. M. S. Demerara ...	69	5	1.25
F. M. S. Straits ...	66	4	1
F. M. S. Jamaica ...	69.5	4	1.25
F.M.S. Mauritius ...	68	3.5	1.25
F. M. S. Mozambique ...	67	3.75	I.25
F. M. S. South Sea ..	67	3.5	4.5
F.M.S. West Indian ...	70	1.5	4
F. M. S. Ceylon ...	68	?	1

From the above, it will be seen that the object is to judge the copra on points which indicate a low percentage of moisture and a high percentage of oil of good colour, and economy in manufacture.

Table V gives the average quality of copra from different sources.

Samples of Ceylon copra examined by the writer with arbitrators at the London Copra Association were superior in appearance to those of Straits Copra. The meat of the former was thicker and of better colour, it was cleaner, and it had a sweeter smell. The writer is of opinion that thinness of flesh is more frequently than not due to inferior methods of preparation rather than to variety of coconuts, soil or climate. All the genuine sundried copra examined by the writer was thicker than the kiln-dried copra.

Improvement of Quality by Legislation.

In certain Crown Colonies, attempts have been made to enforce an improvement in the quality of exported copra by means of legislation. The writer is not familiar with the standard of copra exported from these colonies prior to the introduction of such legislation; but, judging from the few samples of copra from such sources seen in London, the writer was not impressed by their present quality, while brokers who were questioned on the subject were sceptical of the effectiveness of these measures.

Standards of Copra.

As already stated, copra is bought and sold—not on analysis of a sample—but on a standard based on appearance. It should be added that a separate standard has been laid down for each producing country and that there is no general standard. The designation F.M.S. Straits for instance, means Fair Merchantable Sundried Copra from the Straits Settlements or Malay States. It may also apply to copra from the Dutch East Indies re-exported from Malayan ports. In passing, the writer would remark that some of the so-called sundried accepted on the London market appears to be kiln-dried, or a mixture of kiln and sundried copra.

The standard set down for each country of origin represents the average quality of copra received from that country. It should be emphasised that the purchaser of copra, knowing the country of origin of his purchase, sees no sample, but he understands that the delivery will conform to the standard agreed upon for copra of that particular origin. Should the consignment not reach that standard he will arbitrate; but should it be superior to the standard he will naturally have nothing further to say on the matter.

From the above facts it is considered that, even if Malayan planters improved the quality of their copra, there would be no prospect of an immediate corresponding rise in price. All copra dealers state that the quality of copra from the Malay States is satisfactory, and it is therefore evident that copra

of this quality fills a particular demand. It is of course possible either that a local buyer, anxious for high grade copra with which to level up his stocks, may offer a premium for special quality copra, or that a special market for high grade copra might be obtained in Europe by private arrangement. But, generally speaking, the producer can expect no higher price for copra than the standard laid down for the country of origin. It should also be remembered that any improvement in quality would probably involve an increased cost of production, which would not be justified unless a commensurate increase in selling price were forthcoming.

One important manufacturer of edible oil products definitely asserts that the quality of Malayan copra is satisfactory. He points out that modern crushing and refining machinery is competent to deal with medium or poor quality copra, so that it is far less essential than hitherto for copra to be of high standard.

From Tables II and V it will be found that the unit cost of oil from Ceylon copra is 7.35 shillings as against 6.86 shillings per unit of Malayan copra. If crushing and refining plant can effectively and cheaply deal with the latter, it seems probable that the price of Ceylon copra will tend to approximate more closely to that of Malaya. The writer is informed that there are still some factories which prefer the Ceylon product because they are less capable of dealing economically with lower grades. But it is possible that, as old-fashioned machinery is replaced, the present premium on Ceylon copra will gradually disappear, and that an up-grading of Malayan copra will not have a similar effect on its selling price.

Reference to Table I shews moreover, that the proportion of high grade copra is relatively small. This fact, in conjunction with the general satisfaction with Malayan and similar grades, adds strength to the contention that if the standard of Malayan copra were improved and were to approximate to that of Ceylon, there would be no immediate improvement in price. Later, when the market realised that the Malayan product had improved, there would be, not a rise in the price of the improved copra, but a reduction of the premium allowed on Ceylon copra.

Provided that the average oil content of Malayan copra can be definitely raised, even by 2 or 3%, it is possible that a higher price may ultimately be realised. But the evidence at present indicates that such an improvement in quality would not lead to an immediate rise in price. In these circumstances it is unlikely that any proposals for improving the existing quality of copra would find favour with directors or managers of coconut estates in this country.

It may be urged that this report lays undue emphasis on edible oils and ignores the undoubted necessity of vegetable oils for soap making. But the use of oils for edible purposes is undoubtedly the crux of the question, and it is to the increased consumption of edible oils (in such products as margarine and ghee) that one must look for any appreciable recovery of the price of copra generally.

Prospects of Consumption.

Supplies of copra are at present adequate, and as already stated, other oils are coming on to the market in increasing quantities. Perhaps the most encouraging feature of the present position is the fact that the market has been able to absorb the enormous increase of edible oil which has been thrown on the market. This absorption has certainly been at the sacrifice of price, but the absence of large unabsorbed stocks encourages one in the belief that the oil market will require constantly increasing amounts of oil to keep pace with the ever growing consumption. An important opinion was expressed to the effect that the oil market can easily absorb all production of oils for the next 20 years, as consumption is increasing by leaps and bounds.

Summary.

The price of copra since the War has not advanced in line with that of other oil seeds. The grades and values of copra are stated together with the approximate annual production of each. The figures demonstrate that there is a relatively small proportion of high grade copra on the market.

The causes for the fall in the price of copra are examined. It is held that the major reasons are purely economic. The two chief reasons for the present low price are the rapid increase in the world production of other edible oils, and in particular, to the strong competition of the whale oil industry.

The methods of judging copra by appearance, and the qualities which are indicated thereby, are stated.

The method of purchasing copra on standards based upon country of origin and not on sample, is explained. It is argued that any improvement in the quality of Malayan copra will not be reflected in an immediate increase in price.

The opinion is expressed that legislation to enforce improvement in the quality of exported copra has not been effective.

Conclusion.

Owing to the peculiar methods of buying copra on standard, producers cannot hope for any immediate improvement of price for a corresponding improvement of quality. There is probably some scope for copra of good quality —which may command a premium—for grading up native-produced copra. It is extremely doubtful whether any premium obtained, either by private treaty or the recognition of the London market, would be commensurate with the extra cost of production.

For the above reasons, it is evident that the application of any results achieved by research work on the improvement of the quality of copra will not

be altogether easy. It will be necessary to overcome the strong prejudice of the Trade against any change in the present methods of marketing; while, especially in periods of market depression, any suggestion for the improvement in the quality of copra, which may entail additional expense without a corresponding immediate increase in price, may probably be received, in the first instance, with disfavour by producers.

FILM PROPAGANDA IN RELATION TO THE DEPARTMENTS OF AGRICULTURE AND CO-OPERATION.

BY

J. CORRIE,

Personal Assistant to the Director of Co-operation.

Film propaganda has received considerable attention in India, and it was the perusal of an illuminating article* on this subject which planted the germ of the idea in the minds of Co-operative officers in Malaya.

India has recognised the educational value of film propaganda. The 1928 Report of the Royal Commission on Agriculture in India gives an account of the work done in this connection in the Punjab. The Eastern Bengal State Railway initiated a demonstration train which made a tour of Eastern Bengal lasting for about one month. The train was fitted up as a travelling exhibition by the Railway, Public Health, Agricultural, Industries, Co-operative and Veterinary Departments, and by the Indian Tea Cess Committee. Each Department was allotted a bogey carriage, which was appropriately fitted up with pictures, models and samples illustrating its activities. Open air lectures, accompanied by films and lantern slides, were given at each stop. A similar train was arranged by the Government of the Punjab in collaboration with the North Western Railway in December 1927, and made an extensive tour throughout the Province. The Government of the United Provinces provided a demonstration carriage for the use of Mrs. Fawkes, the Secretary of the United Provinces Poultry Association, to assist her in the work of popularising improved breeds of poultry.

In order to aid in their propaganda work, the Madras Agricultural Department has put on the road a travelling motor exhibition. This was considered likely to prove of more use than an exhibition train, such as that used in the Punjab, for the reason that in South India, railways are comparatively few and they do not always pass through the densely populated districts. Moreover, it is only at big towns and centres that facilities exist for halting a train in a siding without dislocating the traffic. It was, therefore, decided to try the experiment of a motor exhibition van which could be taken from village to village in the interior of the districts and brought to the very doors of the *ryots*.

As regards the exhibits which the vans carry, these cover the whole range of the Departments' work. Each is fitted up in a small showcase with a glass front, which fits into its own section, and these can be changed at will depending upon the locality visited and the nature of the exhibition it is desired to give. A large number of posters are carried and these are displayed on boards on the roof and are attached to the front of the counters. Tables and benches are

* "Films in the Making. An Indian Adventure." London Times, 23rd August, 1928.

formed of the shelves in the centre of the van and these are arranged round it to display other samples, etc. The whole, therefore, spreads out into an extensive display and it takes approximately an hour to get it ready or pack it all up ready to move on.

Ploughing demonstrations, etc., are given at the same time and in the evening, lectures are delivered with the aid of the lantern. The caravan goes ahead and chooses a suitable site and makes the necessary arrangements, advertises the coming of the exhibition, and so on, and in due course the big van arrives and the display is spread out. Halts of one to three or four days are made depending on the size of the place visited and the occasion. Local fairs and festivals are attended and the utmost use is made of all "shandais," conferences and gatherings of all sorts. Two assistants at least, accompany the vans and of course there is a reliable driver for each.

The sequel in this country was that the Co-operative Societies Department of the Federated Malay States produced a film entitled "Thrift and Extravagance"—the story of two Malays, Mat and Idris. One has no hesitation in stating that wherever this film has been exhibited amongst Malay peasants, profound interest has been created and the lessons taught by the film have not been lost upon an impressionable people. The film has also been well received by the Press. The film, which was produced in Malaya, depicts some beautiful scenes of the countryside.

The story illustrates the fortunes of two care-free youths at school, who, growing up, arrive at the cross roads of life. One path leads to a life of laziness and extravagance, the other to thrift and hard work. Mat chooses the former, and is seen rising late, employing coolies to tap his rubber, buying "sarongs" on credit, then jewellery, a bicycle and other things he could not afford, all on I.O.U.'s, eventually going to a Chetty to whom his property is mortgaged. He refuses the invitation of the local co-operative society to join their ranks and, when the need arises, borrows from them. The result is that Mat's rubber land is put up to auction at the instance of the Chetty, and he is driven to a life of hardship in the interior and finds that, late in life, he is faced with the problem of having to start all over again.

The second part of the film deals with Idris, who took the path of hard work and thrift. He is seen tapping his own rubber and ploughing his own patch of paddy, while his wife employs herself usefully in making mats. He refuses the invitations of the "sarong" vendor to purchase "sarongs" on credit, and plods along perseveringly, becoming a member of the local co-operative society and paying his subscriptions thereto regularly. He one day hears of an adjoining piece of rubber land, which an Indian is willing to sell at a low price, and gets his local co-operative society to inspect the land, approve of its purchase and advance him the money to do so. Finally, at about the time Mat is driven in desperation to the "Ulu" Idris blossoms out as a man of some affluence; he builds a nice large house and spends the evening of his days in comfort in the bosom of his family.

Recently a second film has been prepared. The title is "Malaya—the Land of Opportunity". This is the story of two Tamil labourers, Muniandi and Kuppan and their wives. Their ambitions are fired by the tale of a returned "kangany" with the result that they decide to leave their homes in Southern India and venture overseas. The film depicts their careers on Sungei Lumpur Estate; of how Muniandi by thrift and perseverance is promoted to the position of head "kangany" and Chairman of the Co-operative Society "panchayat"; of how he becomes the owner of cattle and provides his parents in India with funds to buy bullocks, ultimately drawing on a substantial sum from his society to go on leave with his family; of how Kuppan prefers the "toddy" shop and by gradual stages descends the road to ruin until he ends in prison. At the time when his more prudent comrade departs on his well-earned holiday, Kuppan is left, poverty-stricken and hopeless, to start life anew.

In any effort directed to better the lot of the "kampong" dwellers, the Departments of Co-operation and Agriculture are natural allies. A conference of Field Officers of the Department of Agriculture and the Rubber Research Institute and officers of the Co-operative Department held on 8th October, 1929, unanimously endorsed this opinion. The Conference also arrived at a significant conclusion. It was of the opinion that tours of a propaganda lorry or lorries should be organised for the display of suitable films, etc. and recommended the formation of a Committee to work out details of the scheme. The production of films by means of miniature cinema cameras only was envisaged.

It is as well perhaps to point out it is not suggested that the proposed travelling van should carry films alone. Exhibition samples prepared by the Department of Agriculture and the Rubber Research Institute might be shown. Facilities might be afforded for the display of coloured posters, illustrating the control of disease, pests such as attack rubber and coconuts, and other points of interest. Excellent posters, diagrams and illustrations of this nature are issued by the Department of Agriculture in the Dutch East Indies. Leaflets in Malay and Tamil might be distributed.

An aviculture film, such as was lately featured in Singapore by the Malayan Poultry Farm Association, might be borne in mind. Experiments in the breeding of pedigree cattle have already been instituted at Fraser's Hill and Serdang by the Department of Agriculture. It is not too much to say that wide possibilities are opened up by judiciously directed films and other propaganda for the breeding of better class poultry, goats and cattle. The distribution by the travelling van of improved and tested strains of "padi" seed is yet another possibility.

Investigations of cost have already been made from which it can be confidently claimed that compared with the results to be achieved, the cost would be infinitesimal. Films, and incidentally, wireless broadcasting—the inception of which in Kuala Lumpur is foreshadowed at the time of writing—are everywhere recognised to-day as most potent and helpful media of education. It is therefore to such means as these we turn, in order that the lessons to be learnt from science and economics may be brought home to the "rayat."

THE MALAYAN BUFFALO.

The following is abstracted from an Official Memorandum on "Rinderpest in Pahang" by Mr. R. Macgregor, M.R.C.V.S., Government Veterinary Surgeon, Pahang West.

This breed of animals has reached Malaya via Siam. Large numbers are imported annually both for the cultivation of padi, and slaughter for the supply of beef. They do not breed freely in Malaya, the cause probably being more from neglect in care and feeding than unsuitability of climate. The gestation period is roughly ten months, the calving season being from July to September. They have more compact bodies and are shorter limbed than the Indian buffalo, and in both sexes have wide spreading broad horns in contrast to the short curled horns of the Indian buffaloes. The tongue is short and pointed. They do not bellow, a slight squeal being their only call. The testes are carried high and lie longitudinally against the body.

The predominating colour is black but a few animals have a pinkish skin and whitish hair. The mature animals are practically hairless, but the calves are, however, covered with hair, being similar in all these respects to the Indian buffalo.

The Malayan buffalo is essentially a swamp animal and is used principally for puddling low-lying land, preparatory to padi (rice) planting. The Malay regards the animals as his mainstay in the preparation of land for rice growing; the production of meat for the local market apparently he never considers. He only kills an animal on special occasions such as festival days. Ordinarily he demands such a price for his buffaloes that they cannot compete with the imported Siamese stock for beef purposes.

After the padi is planted, the buffaloes are often prevented from going into swamp areas; they are thus deprived of their natural pasturage and their water holes for wallowing. For these reasons they rapidly lose condition and such treatment is bound to have a retarding effect on their breeding.

If it is impracticable to permit the animals access to water holes or swampy land for fear of damage to the growing crop, then it is necessary to throw water over them twice daily and ensure also that they have sufficient fodder to maintain their condition. A little concentrated food would in all probability be economical to feed under the above conditions, as by maintaining the animals in fair condition they are far more likely to breed.

The buffalo is used extensively by Chinese wood-cutters for hauling timber from the jungle. Such work is suited to them as it is performed in the close humid atmosphere of the jungle; further, they can exert a heavy pull on soft ground.

The Chinese, who use these animals for hauling timber, usually spend time and money on their welfare and ensure that their stock have sufficient fodder and often supplement it with concentrated foods. Such animals may be observed to be in prime condition and are capable of hauling heavy logs of timber.

They have the reputation of being more immune to Rinderpest than those owned by Malays. If they do become affected they are reputed to have greater powers of resistence. It is more likely, however, that they are less liable to become affected as they are often stall-fed or kept confined to small areas, whereas the buffaloes owned to Malays are permitted to ramble about the country-side, uncared for, in poor condition and far more likely to pick up any disease

In conclusion, it may be remarked that the Chinese owner of buffaloes has realised that his animals repay him for the extra care and attention he bestows on them. There is little doubt that the Malay owner would obtain a far greater output of work and a faster increase in growth and numbers of his herd if he would devote the ordinary care that it is necessary to give to domestic animals.

SELECTED ARTICLES.

CINCHONA IN THE BRITISH EMPIRE.*

The value of the cinchona tree (*Cinchona Ledgeriana*) as a source of quinine is common knowledge, but the considerable work undertaken by British medical officers in the past in making use of the product of this tree as a preventive against malaria is not so well known. The cinchona tree was introduced into both India and Java between the years 1854 and 1864. Prior to about 1880, the world's supply of cinchona bark was obtained from the native forests in Ecuador, Bolivia, and Peru. It was only after the export of bark from these regions could no longer be relied upon that attempts were made to grow cinchona elsewhere. The British were amongst the first to succeed in bringing the tree under cultivation. The pioneers were such men as Weddell, Hasskarl, Markham, Ledger, and others, and it was by their efforts that the establishment of important supplies of the drug became a practical proposition.

The early attempts to cultivate the cinchona tree met with considerable success, and private persons took up the business as a commercial proposition. In the early days of cultivation, experiments were made in India, Burma, Ceylon, Malaya, the Sudan, Jamaica, Trinidad, St. Helena, Mauritius, Australia, and New Zealand; but these experiments were not always followed up to a definite conclusion. In Ceylon and India the efforts were successful, but private planting was soon given up and the Government has been mainly responsible for the supplies. Within the Empire, therefore, at the present day, India is the only country where cinchona is grown on a large scale. There are Government plantations in the Nilghiris in the south, in the Darjiling district in Bengal (perhaps the best known), and a more recently developed one in Burma. There are also quinine factories both in the Bengal and Madras Provinces.

A recent paper by Dr. J. M. Cowan, of the Indian Forest Service and officiating Director, Botanical Survey of India, and Superintendent of Cinchona Cultivation in Bengal, entitled "Cinchona in the Empire: Progress and Prospects of its Cultivation" (Empire For. Jour., vol. 8, No. 1 (1929), discusses the present position of the cinchona and the future prospects of its cultivation.

The enormous importance to the human race within the Empire of the perpetuation of supplies of quinine will become evident when the question of malaria prevention is considered. We have within the Empire a large proportion of the malarial tracts of the world. Prof. Muller of Cologne estimates that some 800,000,000 people suffer from malaria; and according to Sir Ronald Ross there are 2,000,000 fatal cases every year. It is further estimated by Dr. Andrew Balfour that the direct loss sustained by the British Empire due

* Reprinted from "Nature," Vol. 124, No. 3136 of December 7, 1929

to sickness and death caused by malaria is in the neighbourhood of between £52,000,000 and £62,000,000 per annum.

Apart from financial considerations, it will be apparent that the responsibilities of the British Empire in this question of malaria prevention or reduction are heavy. The question has become an international one, and an organisation for anti-malarial work has been set up by the League of Nations. The policy of this organisation is primarily the quinisation of affected populations. Hence the cultivation of the cinchona tree becomes a question of first importance. It is to a consideration of this matter that Dr. Cowan's paper is devoted.

In India, then, the cultivation of cinchona is confined to Government activities. It was not until 1910-11 that a similar problem had to be faced in Java. Conferences were held, and manufacturers in Holland and growers in Java came to an agreement by which profits were to be shared and by which prices could be maintained at a level which would show satisfactory returns. The disaster which threatened the Java plantations was averted to a great extent by the adoption of this policy; and supplies are now available for the world demands. That the action taken in Java was thoroughly practical, a comparison between the two countries readily demonstrates. They commenced to give attention to the question about the same time and the facilities in both regions were abundant. Yet Java now produces well over 90 per cent of the world's supply of cinchona bark and India only 4 per cent. A very small percentage of the bark utilised comes from South American forests. The production in India represents only about one-third of the amount actually consumed in the country itself. She is therefore at present not only unable to supply her own demands but also, in common with the rest of the world, is dependent upon the Dutch plantations in Java.

Dr. Cowan explains one of the problems which has so far guided the cultivation of cinchona. "It is a well-known fact that to grow cinchona on the same land for a considerable number of years is a difficult and hazardous undertaking, for the first crop, in some manner not altogether understood, renders the soil, at least temporarily, incapable of producing a satisfactory second crop. As long as there is an unrestricted area of forest land the above factor seems of little consequence, but it makes itself felt more and more as the years go on and there is an increasing shortage of land carrying virgin forest."

Dr. Cowan discusses the methods of growing the crop, for details of which the inquirer is referred to his paper. Harvesting the bark commences in a block from about the fourth year, the material consisting of prunings and thinnings. The crop is reaped, the trees being uprooted so as to obtain the maximum of bark, in about the tenth year. The bark is removed, dried, stored, and then passed on to the quinine factory.

Two problems, in the author's opinion, demand urgent solution: the first is to find additional suitable land, an investigation in which other parts of the Empire should join; and the second is to enhance the output per unit of area.

Research work is also necessary with regard to particular strains which yield high percentages of quinine.

The price of quinine at present is very high—£1.9.6 per lb.—so high as practically to prohibit extensive anti-malarial measures. On this subject the Royal Commission on Agriculture in India in its report (1928) stated: "If India is to embark on any large campaign for fighting malaria, we are convinced that it will be first necessary to reduce considerably the price of quinine within India, and this can only be effected if India is self-supporting in production. To achieve this self-sufficiency a considerable extension to the present area under cinchona will we required..... We are satisfied that, in view of the great importance of extending cinchona cultivation and cheapening quinine, much more scientific investigation is called for than has been undertaken in the past."

Dr. Cowan has done well in summarising the present position and in pointing out the great importance to a large section of the human race of the development of quinine production.

CHEMISTRY AND PLANT DISEASES.*

A Paper read before the Society of Chemical Industry.

At the monthly meeting of the London Section of the Society of Chemical Industry, held at Burlington House, London, on Monday, Mr. H. Martin (Research Chemist at the South Eastern Agricultural College) read a paper on "Chemistry and Certain Problems of Applied Mycology."

Mr. Martin pointed out that the applied mycologist, who was concerned with the control and prevention of plant diseases, was confronted by a host of problems to which he must turn to chemistry for a solution, problems which to the chemist were unique in their diversity and interest. Hitherto the economic importance of applied mycology had not generally been realised, and it was naturally difficult to arrive at an estimate of the loss caused by the disease in crops, although it was extremely large. From the utilitarian point of view, applied mycology offered a field of profitable research, but co-operation with chemistry was essential for the successful evolution and adoption of the majority of control measures employed.

Fungicides.

The most important application of chemistry in applied mycology to-day was the use of fungicides to prevent plant and crop disease, and the industrial chemist would, of course, be interested in the commercial possibilities of fungicides. The extent of the market for such products was illustrated by figures from the French wine-growing districts, where the utilisation of fungicides had reached a high pitch of perfection and had become part of the general routine. It was estimated that the annual consumption of copper sulphate used for fungicidal purposes in these districts amounted to 100,000 tons having a value of £2,500,000.

By hit or miss methods fairly satisfactory copper preparations had been evolved which fulfilled the obvious requirements of a fungicide—namely that the spray should cause no injury to the plant but yet retain its toxicity towards the fungus. Copper sulphate itself would not only cause injury, but would fail as a protection because of its rapid removal by rain or dew, and these objections had been overcome by the employment of the basic precipitates produced by adding certain alkalies to the copper sulphate solution. Millardet, for instance, employed lime for this purpose, and the Bordeaux mixture finally evolved from his and Gayon's trials was still the most popular of the copper containing sprays. Ordinary washing soda had also been added, the resultant mixture being called soda, Bordeaux or Burgundy mixture.

* Reprinted from "The Chemical Age," Vol. xxi, No. 545, December 7, 1929.

Technical Details of Preparation.

The preparation of these mixtures, however, was a troublesome process, and owing to the rapid loss of adhesive properties of the precipitate owing to crystallisation, it was advisable that the mixing should be done immediately before use. There was, therefore, an urgent demand for a substitute which by mere addition to the spray tank would obviate these difficulties. Attempts to produce such a product as, for example, the Borderite paste introduced by Pickering, the basic copper chloride recently re-introduced in Czechoslovakia, and certain copper-containing powders prepared by the interaction of copper with sulphonated residues of oil purification or with alkaline extracts of lignite, had met with but partial success.

In America, where the use of dusts as distinct from sprays had progressed remarkably in recent years, it had become usual to employ mixtures of monohydrated copper sulphate and hydrated lime. These so-called copper-lime dusts possessed many practical advantages, but had not proved as effective as ordinary Bordeaux mixture. It would therefore appear that the successful derivation of the desired substitute would only follow a more fundamental knowledge of the action of Bordeaux and Burgundy mixtures upon the parasite and plant.

An examination of the work done in the past upon the fungicidal properties of sulphur mixtures revealed, in certain aspects, a state of chaos from which a few important conclusions had emerged, but there was an almost complete ignorance of certain fundamental points. The problem was reduced to the consideration of the means whereby the action of the sulphur was brought about, and various hypotheses have been put forward suggesting that an oxidation process occurred before fungicidal action was possible. Directly opposed to this, however, was the discovery by Barker of the formation from sulphur, dusted on the leaves of certain plants, of a compound giving the reactions of hydrogen sulphide. This observation had been followed by the demonstration of the toxicity of hydrogen sulphide to fungus spores in general.

The Behaviour of Sulphur.

At Wye, work had been concentrated more upon the fact that contact with the fungus seemed all-important, and, as the result of the study of the action of sulphur on copper, it was suggested that hydrolysis was concerned in its fungicidal action. If this hypothesis be accepted, it followed that a fungicidal sulphur compound was formed as the result of the hydrolysis. The mechanism of the reaction of sulphur with solutions of alkali and alkaline earth hydroxides was not fully known, but undoubtedly hydrogen sulphide was an initial product. The end products of the sulphur reaction were, on the other hand, well known and the products obtained by the interaction of sulphur with alkaline hydroxides were standard fungicides.

Work just concluded seemed to establish that the fungicidal factor in these substances was sulphur in polysulphide form. By this was meant sulphur combined in sulphide form in excess of that required to form the normal sulphide. Work upon hops showed that the action of the solution upon mildew was determined solely by the content of polysulphide sulphur. There were theoretical reasons for believing that the protective fungicidal action of these spray materials was likewise governed by their content of polysulphide sulphur, but even if the practical demonstration of this probability be delayed, the work on hops was of obvious and immediate benefit, both to producer and consumer. The grower would always be certain of getting a satisfactory fungicide, and the chemist would know at what to aim in the manufacture of these products.

IMPERIAL AGRICULTURAL BUREAUX.

It is of interest to note that the Half Yearly Report of the Director of the Imperial Bureau of Mycology has just been issued. The general work of the Bureaux has consisted in examining specimens from 25 Dominions, States and Colonies, besides specimens from the Rubber Research Institute of Malaya and the Scientific Department of the Indian Tea Association.

Inquiries regarding citrus diseases in Palestine have been dealt with and close touch has been maintained with work on diseases of oranges and grapes for export.

Further important work has been done on gumming and leaf-scald diseases of sugar-cane. This is the worst cane disease in Australia and probably Mauritius, and is spreading in the West Indies.

Work on Bacterial disease of cotton in Tanganyika; on Bacterial wilt of plantains and bananas; on Panama disease in collaboration with Malayan workers; on diseased tobacco specimens from Uganda; on tropical species of Phytopthora; on potato diseases from Cyprus; on *R. bataticola* on causing a serious root-rot of oranges in South Rhodesia were also dealt with.

Other work, not so closely connected with Tropical crops was undertaken, but the above digest gives an idea of the wide and all-embracing character of the work undertaken by these Imperial Bureaux.

A visit to the West Indies was undertaken by one of the officers on the staff of the Bureaux, Mr. S. F. Ashby, to advise on certain phytopathological matters.

This Bureaux also organises a Mycological Conference which is held quinquennially. The last Conference has just concluded and was attended by two representatives from the Department of Agriculture, Straits Settlements and Federated Malay States.

The question of Imperial Bureaux formed one of the main subjects of discussion in plenary session at the Imperial Agricultural Research Conference held in October, 1927. The need for the centralization and distribution of information on agricultural subjects had long been recognised and owing to the great measure of success attained in this respect by the existing Imperial Bureaux of Entomology and Mycology, the Conference fully endorsed the proposal that the system of Imperial Bureaux should be extended to cover as many branches of Agricultural Science as possible. The following article* traces the steps which have led to the present stage of development and describes the new organisation.

The Bureau of Hygiene and Tropical Diseases.

Imperial Bureaux of use to agriculture had their origin in action taken by the Colonial Office in 1908 and 1909. In 1908 that Department established

* Imperial Agricultural Bureaux. W. R. Black, M.B.E., B.Sc. Journal Min. of Agriculture. August, 1929.

the Sleeping Sickness Bureau for the collection and dissemination of information respecting African Sleeping Sickness to medical officers in the Colonies and Dependencies concerned and to investigators engaged in research. In 1912, the scope of this Bureau was widened to embrace all diseases in the tropics both of men and of domestic animals, and it became the Tropical Diseases Bureau. A further development took place in 1926 when, with the publication by the Bureau of a new bulletin of hygiene, its name was changed to the Bureau of Hygiene and Tropical Diseases. The main function of the Bureau as regards tropical diseases is to collect from every possible source information concerning their progress, recognition, prevention and treatment; to collate, condense and where necessary translate this information and to render it accessible to investigators, and to medical and veterinary officers in the tropics with as little delay as possible. The three serial publications of the Bureau are the 'Bulletin of Hygiene', the 'Tropical Diseases Bulletin' (both issued monthly) and the 'Tropical Veterinary Bulletin' (issued quarterly). The two former are concerned chiefly with man, but deal fully with those diseases that are shared by man and his domestic animals; the 'Tropical Veterinary Bulletin' concerns itself entirely with veterinary science. It is intended that this last-named Bulletin shall be taken over in due course by the newly established Bureau of Animal Health (see below). Apart from these publications the Bureau has a valuable library which is open to medical men and others who come to this country from other parts of the Empire. The Bureau is maintained by a grant from Imperial funds and from funds provided by Dominion and Colonial Governments; contributions are also received from the Sudan and certain Indian Provincial Governments. The Bureau is under the control of an honorary managing committee appointed by the Secretary of State for the Colonies. It is housed in the premises of the London School of Hygiene and Tropical Medicine.

The Bureau of Entomology.*

The second of the Imperial Bureaux of service to agriculture had its origin the year after the Bureau first described. In 1909, the Colonial Office set up the Entomological Research Committee to further the study of entomology in tropical Africa. In 1919, the scope of the Entomological Research Committee was extended to cover other parts of the Empire, and the Committee was merged into a new Imperial Bureau of Entomology. Contributions are received by the Bureau at the present time from the British Treasury and from practically all the countries of the Empire. The Bureau issues three publications: 'The Bulletin of Entomological Research,' containing original articles on economic

* Fuller information regarding the work of the Bureaux of Entomology and Mycology and the Royal Botanic Gardens, Kew, will be found in a volume entitled 'Facilities for Advanced Study' and 'Research in Agricultural Science and Cognate Pure Sciences in the United Kingdom', to be obtained, price 1s net, post free, from the Ministry of Agriculture, 10 Whitehall Place, London, S.W. 1.

entomology; 'The Review of Applied Entomology,' which reviews all current literature on economic entomology throughout the world and is published in two series (a) dealing with insect pests of cultivated plants, and (b) dealing with any insects, ticks, etc., conveying disease or otherwise injurious to man and animals; and 'The Zoological Record' (section Insecta), which contains annually as complete a record as possible of the literature of the previous year, chiefly from the systematic standpoint. In addition to its work of centralising and distributing information, the Bureau undertakes the identification of insects. Under its ægis, Imperial Entomological Conferences are held from time to time. In 1926, the work of the Bureau was further extended by the establishment from the Empire Marketing Fund of a parasite laboratory for breeding beneficial parasites for export to various parts of the Empire for the control of insects which are injurious to agricultural plants, stock, etc. The parasite laboratory (the parasite "zoo") is situated at Farnham House, Farnham Royal, Buckinghamshire. The Bureau is administered by an honorary committee of management, the Chairman and members of which are appointed by the Secretary of State for Dominion Affairs and the Colonies. The headquarters of the Bureau of Entomology are housed in the Natural History Museum and the Library and Publication Office are at 41 Queen's Gate.

The Bureau of Mycology.*

The third Imperial Bureau to be formed was the Imperial Bureau of Mycology, which came into being in 1920 following a resolution passed by the Imperial War Conference in 1918. The funds of the Bureau are obtained from contributions by the Dominions, India, the Sudan, Iraq, and most of the Colonial Dependencies. The British Government does not make any direct financial contribution, but by arrangement with the Ministry of Agriculture and Fisheries the Bureau at present occupies a Government building at Kew, rent free. A new and more commodious building for housing the Bureau is in course of erection near the Herbarium at Kew, part of the cost of which is being met by a grant from the Empire Marketing Fund. For the purpose of dissemination of information, the Imperial Bureau of Mycology publishes 'The Review of Applied Mycology,' which gives a monthly survey of all current literature dealing with phytopathology and economic mycology from every part of the world. The Bureau arranges periodical Imperial Mycological Conferences; it undertakes the identification and study of fungous and bacterial plant pathogens; and it maintains a museum of tropical plant diseases, and a lending library for the use of overseas mycologists. Like the Imperial Bureau of Entomology, it is administered by an honorary committee of management appointed by the Secretary of State for Dominion Affairs and the Colonies.

* See footnote, page 99.

Royal Botanic Gardens, Kew.*

Kew fulfills the functions of a Bureau of Botany in all its aspects. On the economic side it has for many years been actively engaged in obtaining from all parts of the world plants of potential economic value, and in the propagation and distribution of these for experimental cultivation in the Dominions and Colonies. Funds have recently been placed at the disposal of the Ministry of Agriculture by the Empire Marketing Board to enable Kew officers to visit overseas parts of the Empire to advise the Governments concerned on botanical and agricultural problems. A botanical survey of the Empire, the fundamental basis for the development and exploitation of the natural vegetable resources, has been continuously in progress for upwards of three-quarters of a century.

The Governments of India, the Union of South Africa, and the West African Colonies maintain officers at Kew for the study of the botanical problems of these particular areas, and negotiations are in progress for the interchange of scientific staff between Kew and other parts of the Empire.

Imperial Institute.

The operations of the Imperial Institute must also receive mention. It carries out valuable work (a) by investigating Empire raw materials (plant, animal and mineral) in order to determine their possible uses and value; and (b) by supplying technical and commercial information relating to such materials. Special Advisory Councils and Committees have been appointed to deal with plant and animal products and with minerals. The Institute publishes a Bulletin which records progress in agricultural, mineral and other industries, with special reference to the utilisation of the raw materials of the Dominions, Colonies and India; it also issues handbooks and other publications on specific products.

The Eight New Bureaux.

The question of the extension of the system of Imperial Bureaux was raised at the Imperial Conference of 1926. The Research Special Sub-Committee of that Conference in referring to the great value of the work of the existing Imperial Bureaux, suggested that further Bureaux of a similar kind might well be established in other sciences, as the need for them is realised and the constituent parts of the Empire agree to their establishment. Again, the Committee on Agricultural Research and Administration in the non-self-governing Colonies, which reported in 1927, thought that the establishment of special Bureaux for plant breeding and soils on lines similar to existing Bureaux would be of great value. As a result of these recommendations, the question of the

* See footnote, page 99.

development of the system of Bureaux was made one of the principal items for discussion at the Imperial Agricultural Research Conference in 1927. That conference recommended the establishment of three further institutions with the title of Imperial Bureaux; for Soil Science, Animal Nutrition and Animal Health; and five further institutions on a smaller scale with the title "Correspondence Centres" to deal with animal genetics, agricultural parasitology, plant genetics (crops and herbage plants) and fruit production; and it also recommended the Centres at which these institutions, with the exception of the Imperial Bureau of Animal Health, should be placed. The Conference considered that the functions of an Imperial Bureau or Correspondence Centre should be to collect, collate and disseminate information of a scientific and technical character; to reply to inquiries on scientific and technical problems from agricultural departments and scientific workers in any part of the Empire; and particularly to facilitate intercourse among group of workers on closely allied problems. On the other hand, it was not considered that the establishment of additional laboratories for attacking imperial problems should form part of the Bureaux organisation.

As regards the administration of these new Clearing Stations, it was recommended that funds contributed for the purpose from the various countries of the Empire should be administered by an authority representative of the contributing Governments. Further, it was recommended that each Bureau should be advised by a technical committee of experts including overseas experts (nominated by the Governments concerned), which should report to the financial supervisory body for the Bureaux.

As a result of these recommendations representatives of the interested Governments met in November, 1928, and drew up a scheme for the establishment of the new Clearing Stations of information, the scheme dealing with the functions and funds of the Centres, the administration of the scheme, the number and location of the Centres, their staffing, accounts, etc., and the rendering of technical advice on the conduct of the Centres by specialists in different parts of the Empire. The recommendations of the Imperial Agricultural Research Conference, 1927, as regards the number and location of the Centres, were confirmed, the Bureau for Animal Health (the location of which was left undecided by the Conference) being placed at the Veterinary Research Laboratory of the Ministry of Agriculture at Weybridge. It was, however, decided to make no distinction in title between the Centres and all the new Centres were designated Imperial Bureaux. These new Bureaux and their location are accordingly as follows:—

Names.	*Location.*
The Imperial Bureau of	Attached to the
(1) Soil Science	... Rothamsted Experimental Station, Harpenden, Herts, England.
(2) Animal Nutrition	... Rowett Research Institute, Bucksburn, Aberdeen, Scotland.

(3) Animal Health	...	Veterinary Research Laboratory, Weybridge, Surrey, England.
(4) Animal Genetics	...	Animal Breeding Research Dept., Edinburgh University, Scotland.
(5) Agricultural Parasitology	...	Institute of Agricultural Parasitology, Near St. Albans, England.
(6) Plant Genetics For crops other than herbage plants.	...	Plant Breeding Institute, Cambridge University, England.
(7) Plant Genetics For herbage plants.	...	Welsh Plant Breeding Station, Aberystwyth, Wales.
(8) Fruit Production	...	East Malling Research Station, East Malling, Kent, England.

While all were described as Bureaux, however, it was decided to organise the first three Bureaux above for the present on a larger scale than the remaining five. The purposes of Imperial Agricultural Bureaux were defined as follows: "To act as effective Clearing Houses for the interchange of information of value to research workers in agricultural science throughout the various parts of the Empire, and for this purpose they should maintain an index of research being carried out in different parts of the Empire and as far as practicable in foreign countries; they should begin by collecting, abstracting and collating information from all sources bearing on the most important problems under investigation in different parts of the Empire; they should keep themselves informed of the general progress of research work within their respective provinces in different parts of the Empire; and they should in appropriate cases summarize available statistics where these are of importance in connexion with their work."

As regards the distribution of information it was laid down that Bureaux should on request supply information within the scope of their work to officials and advisory officers in all parts of the Empire, and should on request also, where possible, supply information to research workers in the Empire, such information to include bibliographies and photo-stat prints of articles on specific problems. As regards the general distribution of information it was recognised that special monographs would have to be published from time to time and that it might ultimately be found desirable to establish a journal when a Bureau had become fully established. The recommendation of the Imperial Agricultural Research Conference, 1927, that a Bureau should not undertake any laboratory or field work involving expense was confirmed, but it was realised that a Bureau would be in a position to be of service to research workers in various other ways and especially by facilitating exchange of workers and meetings of workers interested in the same problems in different parts of the Empire, and the exchange of experimental material for research purposes; and by supplying in-

formation on the best centres for post-graduate study, the best sources of supply of apparatus or equipment, etc.

Funds for the New Bureaux.

An agreement was reached as to the contributions of the Governments of the Empire towards the cost of the new Bureaux.

Executive Council.

As a result of the decisions of the meeting, an Executive Council for the administration of the new Imperial Agricultural Bureaux has been appointed by the Governments of the Empire on the general lines suggested by the Imperial Agricultural Research Conference 1927. The Council controls the fund for the Bureaux, and its distribution among them, and supervises generally the work of the Bureaux. The Chairman of this Executive Council is Sir Robert Greig, of the Department of Agriculture for Scotland, and the Vice-Chairman is Mr. F. L. McDougall, of Australia House.

Officers of the New Bureaux.

The head of the Research Institute to which a Bureau is attached has been constituted in each case *ex officio* Director of the Imperial Bureau, and in the case of each Bureau there will be at least one whole-time officer, paid from the Council's funds, who will be the Deputy-Director or the Chief Assistant for Bureau work.

Official Correspondents.

In place of the scheme of the Imperial Agricultural Research Conference, 1927, for technical advisory committees, specialists in the appropriate sciences are to be nominated as official correspondents for each Bureau by the Governments represented on the Executive Council; and in each country the representative of the Bureau will be the official correspondent to whom the Director of the Bureau may turn for such help as he may require, and from whom he may obtain suggestions regarding the work and activity of his Bureau. It is expected that these correspondents will take a lively interest in the work and functions of the Bureau and facilitate its activities in the interest of the research workers in the Empire as a whole.

The New Bureaux in Operation.

The scheme outlined above has been accepted by the Institutions concerned, and has also received wide acceptance from the different Governments of the

Empire. Six of the new Bureaux are now functioning and the remaining two will be established shortly.

The writer is indebted to the directors of the older Bureaux, of Kew, and of the Imperial Institute; to the Colonial Office; and to the Chairman and Secretary of the Executive Council for the newer Bureaux for suggestions which have been incorporated in this article.

ABSTRACTS.

EXPERIMENTAL CONSIGNMENTS OF PINEAPPLES.

The Empire Marketing Board has assisted the Zanzibar Government in the experimental shipment of fresh pineapples to the United Kingdom. The account of shipments made are contained in an interesting Report which encourages one in the belief that experiments on a small commercial scale on the lines of these shipments might be attempted with advantage. In view of the fact that the time from the picking of the fruit to its arrival in London was about forty-two days, these results are of interest in Malaya as shipments from Singapore would probably take about the same period of time. Omitting consideration of the earlier attempts, one reads that the final shipment described in the report, was of two cases of pineapples of the Smooth Cayenne variety, packed in fairly light wood boxes, with allowance for ample ventilation. Each fruit was wrapped in tissue paper, fine wood-wool being used as packing material. The fruits were picked on 31st October, when they were mainly green to dull greenish orange in colour and appeared to require five to six days to ripen. They had been placed base upwards in a cool ventilated place for two days, after which the stems had been dipped in molten paraffin wax. Packing had been completed by 3rd November and the cases had been placed in the ship's cool chamber on 5th November, the average temperature of which was 39°F throughout the voyage.

It is stated that the fruit arrived without trace of bruising. They were of good shape and size and attractive in appearance. The crowns were generally green and fresh and mould was practically absent from the surface of the fruit. The appearance, however, was rather dull and damp, due in part to the pines being rather ripe coupled with excessive juice content frequently found in this variety, and probably due also to the sweating which had taken place on removal from cold storage.

Trade opinion was generally favourable, size and shape were said to be satisfactory and the absence of any "frosted" appearance was noted. The slightly over-ripe, soft state of some of the fruits was mentioned, but it was considered this could easily be remedied by experience. Reference was also made to the rather dull, damp appearance, compared with the bright, dry Azores pines, but it is considered doubtful whether under existing conditions the colour and appearance could be appreciably improved

Reference is made to recent storage experiments with Queen Pines (the variety used for the canning industry in Malaya) at the Low Temperature Research Laboratory, Cape Town. It was shewn that great differences in keeping quality exist as between different strains of this variety and that keeping quality is often associated with the flat surface of the fruitlets. It was

* Empire Marketing Board, Experimental Consignments, Report No. 7—"Report on Experimental Consignments of Zanzibar "Pineapples."

also shewn that the normal ripening processes in pineapples take place in storage only at temperatures of 43°F. or above. Below this temperature, abnormal changes take place, indications of breakdown occurring after three weeks storage below 40°F, and deterioration setting in rapidly on removal. On the other hand, at 40°-50°F, soft rot, caused by moulds and yeasts, rapidly develops. It would seem, therefore, that 40°-45°F represents the best storage temperature.

REVIEWS.

"The Termite-proof Construction of Buildings in Ceylon."

BY

F. P. JEPSON.

Bulletin Agri. Ceylon, No. 85. 36 pp.

26 pls. 10 refs. Colombo, March, 1929.

Termites are responsible for enormous damage to woodwork in buildings in Ceylon, but in spite of this, there appears to be no definite scheme of building construction whereby immunity from attack may be secured. Fifty species are recorded from Ceylon and of these seven are considered of importance.

The only measures to be adopted against subterranean termites is the construction of termite-proof buildings and the author gives several examples and diagrams of the method of construction.

For the treatment of nests in the ground the use of arsenic and sulphur or calcium cyanide is recommended.

Other species are able to form colonies in isolated woodwork; thus it is obvious that the problem of constructing termite proof buildings requires to be considered from two entirely different aspects.

With the species having the power to form colonies in isolated portions of dug woodwork, the adoption of timber which has been thoroughly impregnated with creosote or some similar substance is essential.

The selection of suitable timbers for impregnation is discussed and the appendices include lists of Ceylon timbers considered in relation to Termite attack.

The proposals laid down by the author are worthy of deep consideration, by architects and engineers, whose co-operation with entomologists should result in the formation of termite-proof schemes suited to any class of building sufficiently valuable to warrant the expenditure on protection.

N.C.E.M.

Year-Book 1928.
Department of Agriculture, Gold Coast.

Bulletin No. 16. Issued by the Director of Agriculture. 1929.

The Year-Book for 1928, of the Gold Coast Department of Agriculture is recently to hand: it is much larger in size than its two predecessors, and constitutes a bulky volume of some 300 pages. It contains some forty papers contributed by various members of the Gold Coast Department of Agriculture Staff and is a volume of considerable interest. It is a matter for argument whether the inevitable delay which such a system of publication involves to

certain papers may not be a considerable drawback, on the other hand, the advantage of having the year's output of a Department grouped together in one publication is in many respects incontestable.

As is to be expected, the papers deal mainly with the cacao industry, sixteen out of the forty papers being concerned with this crop. Other crops dealt with include rice, coconuts, oil palm, maize, cotton and cover crops. Of particular interest to Malaya is the paper by the Director of Agriculture on local cacao prices and the standardisation of quality; it is proposed to reproduce this paper in abstract in a later issue of the Malayan Agricultural Journal by reason of the relationship borne by the points therein discussed to the cognate problem in relation to rubber and other small producers' crops in this country.

Mr. Scott's paper on the sampling of copra is also of interest locally in view of efforts recently inaugurated to standardise this type of produce in Malaya. Attention may also be called to the account of the experiments carried out at Kumasi on a particular sequence of rotation of food crops. This represents an attempt to work out rotation for native agriculturists with a view to superseding shifting chena cultivation and is obviously a parallel of the similar work now being carried on by the Ceylon Department at Dambulla.

Mention may be made of the publication of the research programme of the Economic Botany Division. The publication of research programmes by the divisions of Tropical Agricultural Departments should be strongly encouraged, as it tends to prevent overlap and assists in co-ordinating the work of different Departments working on cognate problems.

The book is profusely illustrated and well presented; and the Gold Coast Department is to be congratulated on its production.

H.A.T.

DEPARTMENTAL NOTES.

The Agricultural Advisory Committee.

Under the Chairmanship of the Director of Agriculture, a meeting of the recently augmented Agricultural Advisory Committee was held at the Department of Agriculture, Kuala Lumpur, on 24th January, 1930.

The Committee as now constituted is representative of the various agricultural industries and commerce of Malaya, and in addition, of the Co-operative Societies Department, the Rubber Research Institute of Malaya and the Education Department.

The Committee dealt with a wide range of agricultural subjects, supported by reports and memoranda which were circulated to members before the meeting. The following notes indicate the range of the discussions.

Tapping of Sugar Palm (Arenga Saccharifera).—The Committee was supplied with a memorandum on the progress of the experiments conducted at Serdang. The Chairman drew attention to the more important points and especially to the enormous variation in the amount of juice collected from individual trees.

Pineapples.—The meeting was informed of the present position of the market for Malayan pineapples, the growth of the trade and the gradual improvements effected in the canning industry. Publicity, through exhibitions in the United Kingdom, was stimulating demand and it was proposed this year to push the sales of Malayan pines on Continental markets. The Chairman pointed out that the real issue is that of maintaining an established industry of some considerable size with an exportable value of £1,000,000 sterling, rather than considering projects of extension. A projected Pineapple Experimental Station at Singapore was discussed. The Station is designed to investigate the possibility of growing pineapples as a permanent crop. The need of economic investigations in addition to the usual scientific experimental work was considered by the meeting. The Chairman agreed to the principle but thought that the first step is to commence the experimental work.

Fertilisers Enactment.—The draft of an Enactment drawn up by a small Sub-Committee was discussed. Similar action is being taken in Ceylon, but the Malayan draft is based on the English Enactment. The machinery for enforcing the Enactment was considered. The Committee agreed that the provisions of the Fertilisers Enactment as drafted are likely to meet a definite want and recommended its transmission to Government.

Research Programmes prepared by Heads of Divisions.—Various points in connection with research programmes were raised, amongst which were the publication of results, the manufacture of coir matting, work on pepper and the charges made by the Department for soil analyses.

Coconut Research.—The desirability of extending the experimental area under the control of the Department was discussed. Size and site of the area, planting distances, possibility of co-operative work with Managers of various estates on small experimental areas in the different coconut districts in Malaya were among the items discussed under this head.

Field Officers Reports.—Monthly reports are submitted to the Committee and are considered at its meetings. Arising from one such report the question of policy of the Department was discussed, with regard to disease work on rubber, in view of the possibility that such work might overlap with the work of the Rubber Research Institute. The Chairman emphasised the vital importance of co-operation between the Department of Agriculture and the Rubber Research Institute with both European and the native planters of rubber, and was of opinion that any arrangement which makes for smoother working between the two Departments should be encouraged. This view was supported by the Director of the Rubber Research Institute.

Among other subjects dealt with at the meeting were financial estimates, mushroom culture, publications, padi distribution for seed purpose and coconuts in estate labourers' diets.

Coconut and Oil Palm Research Committee.

At a meeting of this Departmental Committee, held on January 13th, 1930, the research work contemplated by the Department was reviewed in the light of progress already made in this country and elsewhere. Amongst other important matters upon which decisions as to policy were reached was for the establishment of two Meteorological Stations—one at the Coconut Experimental Station, Klang, and the other at the Rice Experimental Station, Titi Serong, Perak. At these stations, wet and dry bulb recordings will be taken four times daily, and evaporimeters will be installed, to enable a study of changes of moisture conditions and the corresponding changes in growing plants during the most important hours of the day.

Until positive scientific results have been obtained on the question of quality of copra, it was agreed that further consideration should be postponed on the somewhat controversial subject of marketing copra.

Statistical Division.

The Governments of the Federated Malay States and Straits Settlements have approved the appointment of a Statistician in the Department of Agriculture. The value of agricultural statistics has not been overlooked in the past, but the work has been much hampered by lack of facilities for the collection of data.

Mr. J. Gordon-Carrie, B.Sc., Deputy Supervisor of Rubber, F.M.S., and Deputy Registrar-General of Statistics, S.S., who in the past has been entirely concerned with rubber statistics, is transferred to the Department of Agriculture

as from January 1st, 1930, and will compile not only the rubber statistics, but data concerning other crops in Malaya. The arrangement is for one year only in the first instance and will be subject to review at the end of that period.

Leave.

Mr. F. S. Ward, Assistant Mycologist, has been granted seven months and twenty-nine days leave on full pay, with effect from the 10th January, 1930, inclusive.

Mr. W. N. C. Belgrave, Plant Physiologist, has been granted 11 days leave on full pay from 18th January 1930, inclusive, and two months and nineteen days leave on half-pay from 29th January, 1930, inclusive.

The leave of absence granted to Mr. B. Bunting, Agriculturist, has been extended for one month on half-pay with effect from the 22nd December, 1929, inclusive.

Mr. G. H. Corbett, Government Entomologist, returned from leave of absence on the 24th January, 1930.

Mr. L. A. J. Rijk, Librarian and Translator, returned from leave of absence on the 28th January, 1930.

FROM THE DISTRICTS.

The Weather.

January has been a moderately dry month on the whole but very heavy local afternoon showers fell in places, notably in and around Kuala Lumpur and in parts of Larut district and Bruas sub-district in Perak. Dry conditions continued in Pahang accompanied by strong breezes on the East Coast.

Remarks on Crops.

Rubber.—Wintering had commenced in all districts at the close of the month and is reported to be proceeding very rapidly in Province Wellesley, where yields of latex have fallen off in consequence.

In West Pahang there has been an increasing tendency of late for Chinese small holders to plant catch crops among their young rubber. Bananas are fairly extensively used for this purpose, as are also ground-nuts and soya beans. The Agricultural Field Officer, Pahang West, now reports that ginger is also beginning to come into favour as a catch crop with rubber.

From the same source a report states that a Chinese cultivator in the district of Raub has recently budded his whole area of 400 acres. This may possibly have been an outcome of the bud-grafting demonstration given by the Rubber Research Institute at the Bentong Agri-Horticultural Show last September, although no definite information is to hand on this point.

In connection with the recent removal of the heavy import duty on alum, enquiries were instituted as to the extent to which this substance is now being used as a latex coagulant by small cultivators. Complete information is not yet to hand but sufficient reports have been received to indicate that alum has ceased almost entirely to be used as a coagulant for rubber latex.

The usual inspection and enforcement of control measures for Mouldy Rot disease were continued throughout the month in all areas where the disease exists. A newly infected area was found at Sitiawan in Perak. It has been decided to make a special effort to foster a system of regular preventive painting throughout all infected areas with the object of lessening the number of cases of recurrence of the disease and the consequent enforcement of control measures, which include cessation of tapping. This cessation of tapping, necessarily a part of successful control measures, often leads indirectly to spread of the disease, notwithstanding all precautions, through dismissed tappers with infected knives and clothes obtaining work elsewhere.

Padi.—Reports from Krian indicate that the crop through the greater part of the district may prove to be better than was anticipated, for it improved considerably in appearance during the month, water being ample and damage by the leaf-hopper having subsided. This does not include the late-planted

Gunong Semanggol—Selinsing—Brieh areas, which in late seasons always necessarily receive irrigation water later than the main portion of the land covered by the Krian irrigation scheme, and which consequently suffer badly in such seasons, of which the present one is an example. The prospects here, where irrigation facilities are defective, is very poor indeed, but are even worse in Province Wellesley, where no irrigation facilities exist and where the weather throughout the season has been exceptionally unsuitable for padi. In the earlier planted areas of Krian, flowering was general at the end of the month.

A good crop is expected in the Kuala Kangsar and Upper Perak districts and in the sub-district of Selama, in all of which areas the crop is at the flowering stage. In Larut district proper, prospects are not bright, owing to late planting from lack of water and subsequent unsuitable weather.

In Kinta and Batang Padang districts of Perak a fair crop was being reaped at the end of the month, but the crop in Lower Perak has again suffered somewhat severe damage from rats.

A good average crop is being harvested in Negri Sembilan, and in Malacca, where harvesting is also in full swing, yields obtained are reported to be very satisfactory.

In West Pahang, departmental pedigree strains, distributed to approved cultivators, have proved their worth, in some cases having given exceptionally heavy yields. Actual comparative figures are not yet available, but cultivators are so satisfied with results that arrangements have been made for extended distribution for next season.

No regular departmental reports are received from the important padi areas of Kedah and Kelantan, but information to hand indicate that the Kedah crop is unusually poor, owing to exceptionally dry weather throughout almost the whole of the padi season.

During last year an area on the Rompin river in Pahang was explored with the object of determining its possibilities as a padi area. Analyses of samples show that the soil is satisfactory and a recent comprehensive report by the Agricultural Field Officer, Pahang East, indicates that an area of approximately 8,000 acres is eminently suitable for padi cultivation. There would appear to be an adequate water supply to provide full irrigation for this area.

Tea.—To date, 5,700 acres have been alienated for the cultivation of tea on Cameron's Highlands and further applications are being received.

The Agricultural Field Officer, Perak South, reports that a good stand has been obtained by planting basket plants and stumps, of the thickness of a lead pencil, on an area where planting young seedlings and seed-at-stake had proved unsuccessful on account of dry conditions.

Tuba Root and Chillies.—Attention was directed last month to the possibilities of profit to the small cultivator by growing chillies. Some interesting figures are now to hand relating to the cultivation of tuba, with chillies as a

catch crop, in the district of Kinta. The tuba yielded 12 pikuls an acre after 18-24 months and the produce was sold locally, ungraded, for from $16 to $20 a pikul or from 32-40 cents a kati. The chillies yielded from 80 to 100 katis an acre after four months and were sold locally for from 24 to 30 cents a kati.

Jelutong and Coffee.—In the Temerloh district of Pahang an area of 940 acres has been alienated for the cultivation of jelutong. Up to the present, some 25 acres have been planted at 30′ x 60′ and coffee planted as a catch crop. The jelutong trees are said to be making good growth.

Notes on Demonstration Stations and Padi Test Plots. Perak.—The Poultry Station at Kuala Kangsar has made a good start, both fowls and ducks having laid well throughout the month. Two incubators, each of 100 eggs, were set with both fowl and duck eggs. As advertised elsewhere in this journal, a limited number of eggs is available for sale from time to time at $4/- a setting.

Negri Sembilan.—Twenty nine budded citrus were distributed during the month from Seremban Station.

The crop has been harvested at Jelebu Padi Test Plot but yields are not yet to hand.

Pahang.—At the Kuala Lipis station cowpeas and ground-nuts were harvested during the month and eight standard plots for tapioca trials were prepared. Plots were also laid down with various cover crops for demonstration purposes. Harvesting was completed at the Dong and Temerloh Padi Test Plots. Yields from the latter were somewhat disappointing: figures are not yet available regarding Dong plot.

The annual report on the Pekan Padi Test Plot is now to hand. Notwithstanding the dry season, some of the pedigree strains gave very satisfactory yields thus indicating their suitability to withstand dry conditions.

Malacca.—At Pulau Gadong Padi Station harvesting commenced with short season padi varieties on January 9th and is still in progress. Good yields are being obtained. A party of over 100 "Penghulus" and others visited the station on January 21st.

MARKET PRICES.

January, 1930.

Rubber.—The average London price of Rubber for January, 1930 was 7.3 pence per lb., being a fall of .6 pence over the corresponding figure for December, 1929. The highest price quoted was $7^{15}/_{16}$ d., while the lowest quotation was $6^{15}/_{16}$ d. The average Singapore price was 24.6 cents, against $26\frac{1}{2}$ cents in December; the highest price being $26\frac{3}{4}$ cents and the lowest 23 cents.

Copra.—On December 28, Straits F.M.S., copra was quoted at £22-10-0 per ton C.I.F., compared with Ceylon F.M.S. at £23-15-0 per ton. In Singapore, copra varied from $9.35 to $9.45 S.D., and $8.95—$9.00 F.M. per picul.

Palm Products.—Prices easier: Hull on January 8th reports palm kernel oil at £31.10.0. Palm oil quotations, early in January were as follows:—Lagos 33/6, softs 32s., mediums 32s., hards 33/6, bleached 34/6, spot.

Coffee.—Supplies small, meeting a dull market moving in buyers' favour Fine grades remain steady. Kenya, bold common to fine general 99s-157s. Medium 83/6-110s. Costa Rica bold common to good general 97s.-128s.

Tapioca.—Med. Pearl 23/- to 24/- per cwt. E.I. Flake fair, spot 21/- per cwt.

Singapore, January 18th quoted Flake $5.35, Pearl Med. $8.

Sago.—Singapore prices lower: Pearl $7\frac{7}{8}$, Flour $4.20/4.22\frac{1}{2}$.

Spices.—Cloves. Penang 1/7-1/9. Zanzibar, $10\frac{3}{4}$d. Mace. Ord. to Gd. 3/3-3/10 per lb. Pepper. No material change, but forward prices firmer. Spot Singapore $11\frac{3}{4}$d. Singapore quotation $42/43.

Clove Oil.—(90/92%) 8s. per lb.

Sisal Hemp.—E. African, 33/10-35/10.

Kapok.—Java $11\frac{1}{4}$-$11\frac{3}{4}$d; Calcutta 8-$9\frac{1}{2}$d. ; Ceylon $10\frac{3}{4}$-$11\frac{1}{4}$d.

Gambier.—Singapore quotations, January 18th, $\$9\frac{1}{2}/9$ per picul; Cube No. 1 & 2. $\$15\frac{1}{4}$ per picul.

The above price list is intended to indicate the trend of prices during the latter half of December and the first half of January. With the exception of rubber for which the daily quotations for January have been examined, the information given has been drawn from the Singapore Chamber of Commerce Market Reports for January; "The British Trade Journal & Export World" for January; "Tropical Life" January; "The Chemist & Druggist," January 4th. "The Chemical Age," January 4th. and "Perfumery & Essential Oil Record," December 23rd.

Prices in Sterling are London quotations, while those in Straits Dollars ($1 = 2s. 4d.) are Singapore quotations.

Erratum: Vol: XVIII, No. 1 January 1930, page 59: for "Olive Oil" read "Clove Oil."

RUBBER STATISTICS.

Stocks of Rubber held by Dealers and on Estates of over 100 Acres on 31st December, 1929, together with the Declared Production of the same Estates and certain Export Figures.

(Stocks Compiled from Returns by Estates and Dealers.)

Territory.	Stocks.		Estates declared production during the month. Estimated dry weight, all grades.	Total exported by estates and dealers during December. (*a*)
	Stocks held by dealers.	Estimated dry weight total stock held by estates.		
	Tons.	Tons.	Tons.	Tons.
Federated Malay States ...	11,538	16,222	14,613	22,419
Johore ...	2,343	5,616	4,234	8,280
Kedah ...	445	2,332	2,367	3,825
Kelantan ...	(*b*)	(*b*)	(*b*)	558
Trengganu ...	(*b*)	(*b*)	(*b*)	128
Perlis ...	(*b*)	(*b*)	(*b*)	27
Straits Settlements, Malacca ...	2,247	1,986	1,649	
,, Province Wellesley ...	161	867	687	
,, Dindings ...	42	155	113	3,628*
,, Singapore Island ...	27,949	379	293	
,, Penang Island ...	5,208	15	15	

(*Estimated.)

NOTES.—(*a*) Exported means left the territory irrespective of destination.

(*b*) Figures not available.

(*c*) With effect from January it is intended to publish these Statistics in a new form which will give further details.

J. GORDON-CARRIE,

Deputy Registrar-General (Statistics), S.S. & F.M.S.

Deputy Supervisor of Rubber (F.M.S.)